MECHANICAL ENGINEERING

• SEPTEMBER 1952 •

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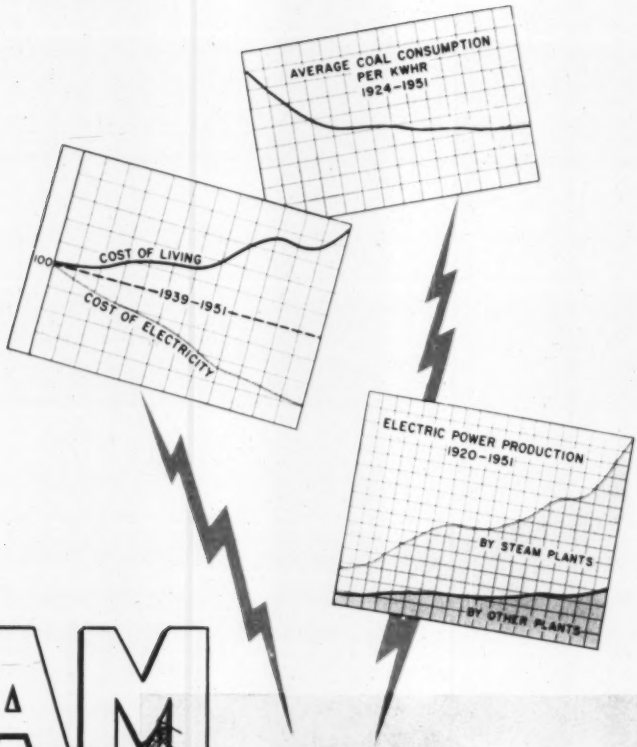
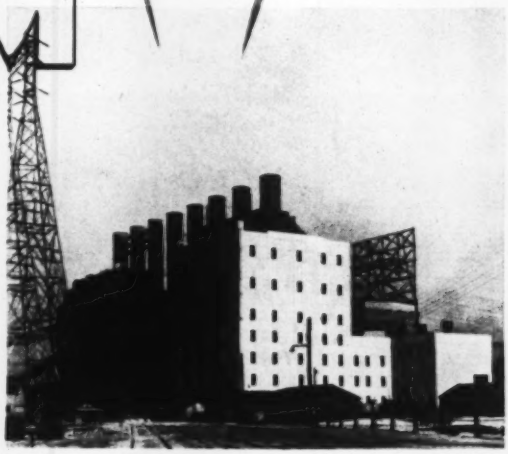


AMERICA'S BIGGEST BARGAIN

STEMS FROM STEAM



Take a quick look at the stubs in your check book—compare what you paid last month for electric power with what you paid for other essential services—and you'll agree that rising costs and shrinking dollars simply don't apply to electricity, for 70 years America's biggest bargain.

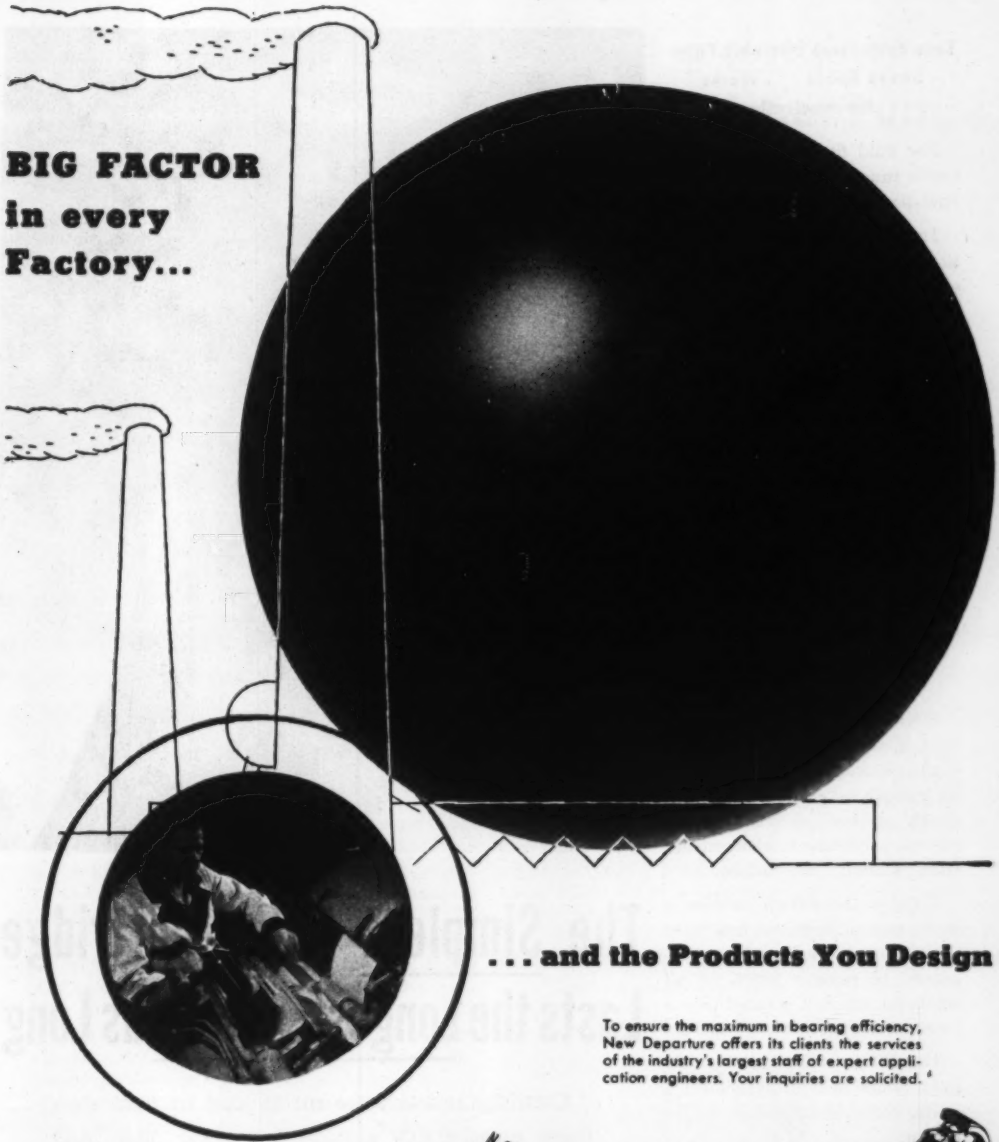
Steam is big business in America's electric power industry—70 per cent of all electricity is produced by steam-operated equipment, because steam is the most economical medium for harnessing fuel energy. Reflected in the steady decline in power rates are decades of cooperative technological progress by power company engineers and manufacturers of steam generating equipment.

The three little charts reflect how steam engineering progress has blossomed . . . how steam cultivates and holds the interest of physicists, mechanical engineers, metallurgists, civil engineers and a host of other technical men whose knowledge and experience have been applied to developing and applying equipment for the efficient conversion of fuels into usable energy. The charts forecast what the professional curiosity of America's young engineers will produce in years to come in the fertile field of steam engineering.

BABCOCK & WILCOX

G-554

BIG FACTOR in every Factory...



... and the Products You Design

To ensure the maximum in bearing efficiency, New Departure offers its clients the services of the industry's largest staff of expert application engineers. Your inquiries are solicited.

The Great Ball of New Departure is your guide to *top quality* in ball bearings . . . *top service* in ball bearing application. New Departures are a tremendous influence in every phase of modern industry. Machines start more easily . . . carry their loads more efficiently . . . preserve their precision through a longer useful life . . . because of New Departure's *balanced* design.

This true *quality balance* can be a big factor in your design problems, a factor which will enable you to deal adequately with the forces of friction. New Departures are so accurately made, so friction-free, that they actually reduce costs as they reduce friction. Keep your eye on the BALL to be sure of your BEARINGS!

NOTHING ROLLS LIKE A BALL

NEW DEPARTURE

BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

MECHANICAL ENGINEERING, September, 1952, Vol. 74, No. 9. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢, to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

Less Expensive Micronic Filter Saves Space . . . Works Mechanically

For fluid filtration in the micronic range, many designers are now specifying Cuno MICRO-KLEAN.

In many cases, the MICRO-KLEAN turns out to be the most efficient—as well as the most economical—method of filtering many fluids.

The MICRO-KLEAN cartridge is a simple, compact structure of "felted" fibres, with no internal or external supports to take up space and complicate installation. It gets its strength from the resinous impregnation and polymerization. It won't swell or shrink, soften or harden, rupture or channel, or otherwise release contaminants into the discharge flow.

Fewer cartridge changes

MICRO-KLEAN's greater dirt-holding capacity comes from maximum porosity (85-90%) and from its exclusive "graded density in depth", permitting smaller particles to penetrate further, rather than "loading" the surface.

Cuno MICRO-KLEAN handles a wide range of fluids and flow rates with low pressure drop. It is guaranteed to remove 100% of all solids for which it is rated plus a large percentage down to 1 micron.

Capacities: a few to over 800 gpm. Single or multiple cartridge units. External or built-in application.

Cuno Engineering Corporation
Dept. 651C, South Vine Street, Meriden, Conn.

Please send information on Cuno MICRO-KLEAN for following installations .....

.....

Name.....

Company.....

Address.....

City.....Zone....State.....

Please attach to business letterhead

The Simplest Filter Cartridge Lasts the Longest...Twice as Long

Cartridge renewals are cut at least *in half* when Cuno MICRO-KLEAN replaces any other filter. And throughout its service life, MICRO-KLEAN is *guaranteed* for specific performance.

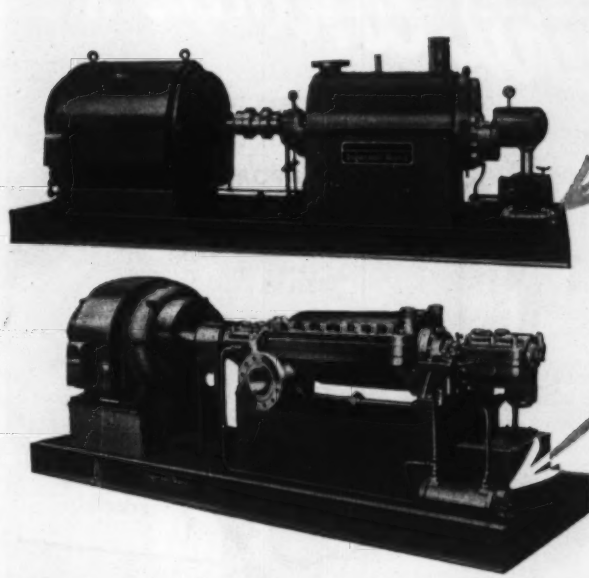
CUNO

Fluid Conditioning

Removes More Sizes of Solids from More Kinds of Fluids

Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN

properly cooled lubricating oil a certainty in these Ingersoll-Rand Centrifugal Pumps



they're Ross Exchanger equipped

● Operating efficiencies of I-R multi-stage centrifugal pumps *stay higher longer,* with less and easier maintenance required.

Materials that are carefully selected for dependability, plus simple, more rugged construction, are given as the principle reasons for this claim by Ingersoll-Rand . . . *the very reasons that Ross Exchangers are used so extensively!*

For, on those pumps that do require oil cooling, the exchanger has a very important function. It is a vital part of a complete force feed system that supplies lubricating oil *at the proper temperature* to the thrust and radial pump bearings, and in some instances, the driver bearings, depending on the installation. Without an efficient exchanger, the oil might reach such high temperatures that it would break down, losing its necessary lubricating qualities, and thereby risk seizure and damage of close-clearance parts.

Therefore, in high pressure refining service, boiler feed service in central stations and industrial plants, and allied applications, it's easy to understand why Ingersoll-Rand provides the built-in protection of Ross Type BCF Exchangers on most of its multi-stage centrifugal pumps.

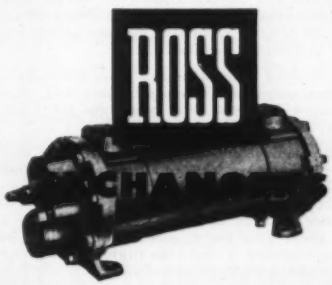
Compact, all-copper and copper alloy construction; pre-engineering, full standardization, mass production are Ross Type BCF features that hold great benefits for Ingersoll-Rand and other manufacturers of pumps, Diesels, compressors, turbines and numerous types of primary equipment. Information in new Bulletin 1.1K5, describes these benefits specifically. Write.

KEWANEE-ROSS CORPORATION

DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

1448 West Avenue Buffalo 13, N. Y.

In Canada, Horton Steel Works, Limited, Fort Erie, Ont.



Serving home and industry

• Frequently you give serious thought and attention to *pressure* and *temperature control*. This is quite natural because it means better operation and more production and often prevents damage. But what about the *third control—entrainment control*. Lack of this control can be just as costly as lack of pressure and temperature control.

Lack of the third control can mean shut downs and loss of production due to entrainment wear in engines and process equipment. Larger slugs of entrainment have been known to blow off cylinder heads of reciprociting engines and to ruin thrust bearings of turbines.

Lack of third control means poor efficiency of superheaters, steam ejectors, dryers and other equipment. It means dirty pipe lines and fouled valves.

End this damage *once and for all* with Hi-eF Purifiers. They remove 99% of all entrainment. Individually guaranteed, Hi-eF Purifiers are the most economical protection you can buy . . . they cost no more than an ordinary separator. Write us today about your entrainment problem. Let our engineering staff, without the slightest obligation, give you the proper solution.

PURIFIER DIVISION,

THE V. D. ANDERSON COMPANY

1975 West 96th Street • Cleveland 2, Ohio

Gentlemen: Please send additional information on Anderson Hi-eF Purifiers.

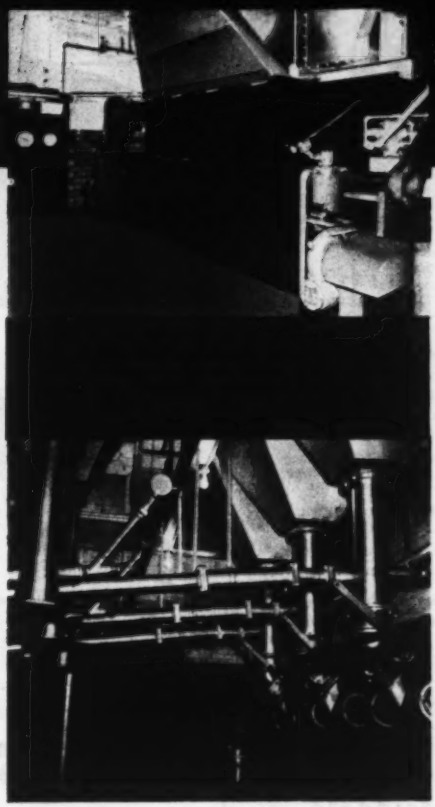
Name.....

Company.....

Address.....

City.....**Zone**...**State**.....

Nash Motors SELECTS
DETROIT ROTOGRATE STOKERS



Nash Motors, Division of Nash-Kelvinator Corporation purchased two 100,000 pound per hour RotoGrate Stokers for their Kenosha plant. Boilers are Babcock and Wilcox 4 drum Stirling with superheaters and economizers. A similar stoker unit was purchased for the Nash Milwaukee plant.

Detroit RotoGrate is an improved spreader stoker. Grates move slowly forward to discharge the ash at the front. Coal feed, grate speed and air supply are synchronized at all capacities. A wide range of Bituminous Coal or Lignite may be burned. Controlled high turbulence and rugged, dependable cinder reinjection system contribute to fuel economy. Grates are of unique design which permits more burning capacity per square foot.

Write for RotoGrate Bulletin.

DETROIT STOKER COMPANY
GENERAL MOTORS BLDG., DETROIT 2, MICH.
District Offices in Principal Cities · Works in Monroe, Mich.

Morse ...leading producer of precision-built chain drives

MORSE SILENT CHAIN DRIVES

Industrial type: Morse Industrial Silent Chain Drives are quiet, smooth-running, reliable. They give long years of efficient service with fewer service interruptions.

Automotive type: Morse Automotive Silent Chain Drives are precision-made, mass-produced. The experience and production facilities necessary to supply thousands of these drives daily enable Morse to supply highest-quality, economical industrial drives.

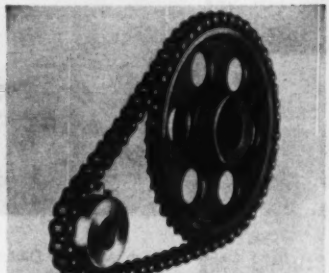
MORSE STANDARD ROLLER CHAIN DRIVES

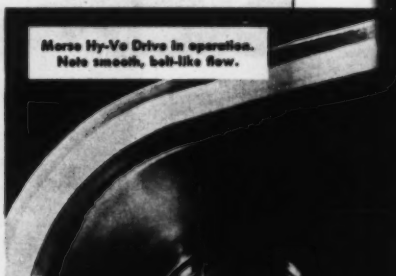
Morse Standard Roller Chain Drives are 99% efficient. They use teeth, not tension; won't slip.

Morse Standard Roller Chains are available from distributors' stock from ¼" pitch to 2½" pitch, with horsepower capacities ranging from less than 1/10 H.P. to extremely heavy horsepower applications using large-pitch, multiple-strand chains. Corresponding sprockets available in types A, B, and C.

MORSE HY-VO DRIVES

Sensational, proved Morse Hy-Vo Drives transmit more horsepower at higher speeds and lower cost than any other standard power transmission drives. They cut operating costs per hour up to 50%, operate 45% more quietly, give up to one-third longer service life. Morse Hy-Vo opens the way to transmitting far more horsepower from smaller, faster engines —without costly outboard bearings and mounts.





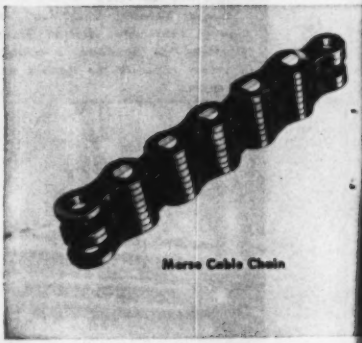
MORSE DOUBLE-PITCH ROLLER CHAINS

Morse Double-Pitch Roller Chains give positive drive. They cost less, weigh less, and give long life comparable to that of standard roller chains. Single and double-duty sprockets available.

MORSE CABLE CHAINS

Precision-built for heavy-duty service. Standard pitches from ½" to 1", with average ultimate breaking strength of from 3900 pounds to 49,000 pounds.

For information on any of these precision-built power transmission chains or chain drives, write Morse direct or phone your Morse distributor.



M·P·T BASIC FORMULA

MORSE CHAIN COMPANY
Dept. 384, 7601 Central Ave. • Detroit 10, Michigan

Morse *means* Power Transmission

MORSE
MECHANICAL POWER TRANSMISSION PRODUCTS
BW

This 7-Letter Word Tells the Story

• There are many descriptive words and phrases we might use to prove the effectiveness of Zallea Stainless Steel Expansion Joints as the ideal medium to absorb thermal expansion and contraction in pipelines. But no single word has more convincing meaning . . . more significance than the simple 7-letter word . . . "*reorder.*"

Over the past 23 years, thousands of industrial organizations have expressed their confidence in our products by reordering not once, *but time and time again!*

Here's a sample of the record:

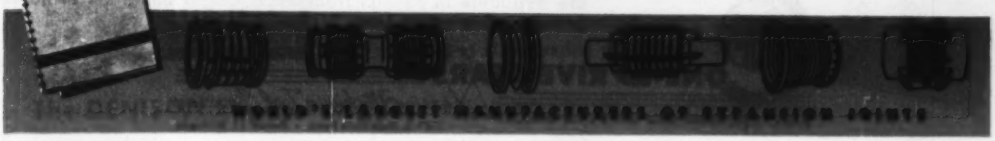
Company	Number of Orders Placed*	Since
American Viscose Corp.	79	1940
Bethlehem Steel Corp.	51	1935
Carbide & Carbon Chemical Co.	93	1936
Consolidated Edison Co.	115	1933
Dravo Corporation	53	1939
E. I. du Pont de Nemours & Co., (Inc.)	308	1934
Ebasco Services	46	1934
Hercules Powder Co.	133	1937
Koppers Co., Inc.	165	1942
Nordberg Mfg. Co.	174	1942
Sun Oil Co.	60	1935
Texas Co.	261	1938

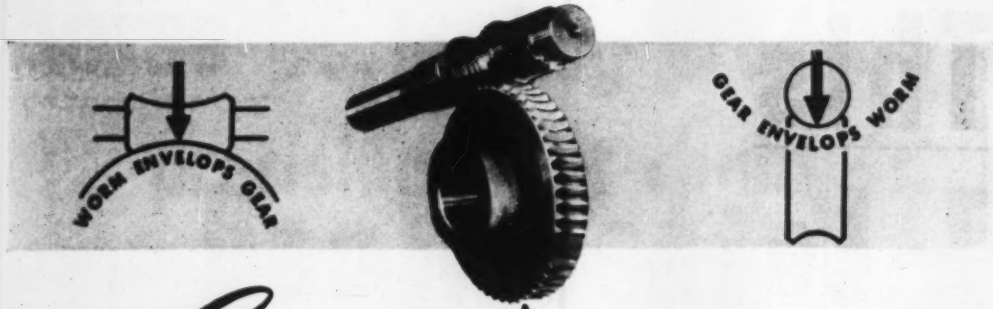
**Including as many as 485 expansion joints in a single order!*

This acceptance is your assurance of the dependable, economical performance you'll receive when you, too, order and *reorder* Zallea Stainless Steel Expansion Joints. Why not write us *today*? Zallea Brothers, 820 Locust Street, Wilmington 99, Del.

Catalog 47 and Bulletin 351 describe the complete line of Zallea Expansion Joints and Flexible Connectors. Write for copies today.

Zallea
EXPANSION JOINTS





We've *Standardized* Cone-Drive Gears for You!

Here are the reasons why . . .

1. Lower Cost . . . . . . As little as ⅓rd the cost of special gear sets and speed reducers.

2. Faster Delivery . . . . . Your order may be shipped from stock in as little as 24 hours! Practically any size and ratio shipped within one week.

3. Interchangeability . . . Cone-Drive gear sets of different ratios are now interchangeable in the same housing as long as center distances are the same.

4. Ready Replacement . . Use of standardized parts throughout means simple, quick and low cost replacement when required.

Why all this is possible . . . In Cone-Drive double enveloping gears there are no circular or diametral pitch limitations to consider. This vital design feature has now permitted STANDARDIZATION of right angle reduction gearing, made possible mass-production of gear and worm blanks, and simplified and speeded manufacture and assembly.

And don't forget . . . . . . When you specify Cone-Drive double enveloping gears, you can use much smaller gear sets to carry a given load; you can save space and weight; and you get unparalleled smoothness. You get all of these simply because Cone-Drive Gears have (1) a greater contact area per tooth and (2) more teeth in contact.

What to do . . . . . . ***Write, phone or wire today for Catalog No. 700—or better yet, ask for specifications of the STANDARD Cone-Drive gear set most nearly meeting your power and ratio requirements. They are available in ratings from fractional to hundreds of horsepower and in ratios from 5/1 to 70/1.***

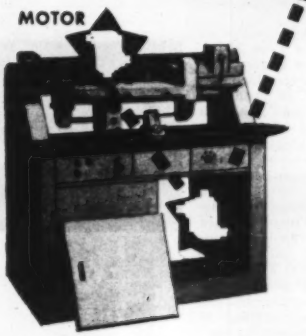
CONE-DRIVE GEARS
Division, Michigan Tool Company
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS
7171 E. McNichols Road • Detroit 12, Michigan

Same unit does EITHER job!

Standardize for Simplicity on Denison's

"The Finest Money Can Buy!"

PUMP MOTOR



A typical production tool where both pump and fluid motor needs can be met by PUMP/MOTORS. Many other circuit applications will get extra value and performance from new *radially balanced vane-type, dual-purpose* PUMP/MOTORS.

DENISON Hydraulics

For *continuous duty* at 2000 psi

One type of unit does *BOTH* jobs!

Where there's a fluid motor, there's a hydraulic pump — and there's a Denison PUMP/MOTOR model for low-cost efficiency on either job!

Every PUMP/MOTOR is ready for use as either pump or motor *without alterations of any kind.* They are easily converted for clockwise or counter-clockwise rotation. Opposed inlet and outlet porting assures complete radial hydraulic balance of the rotor — resulting in minimum surge and pulsation, with less wear on all moving parts. Radially balanced vanes contact the cam ring with dual sealing edges — low loading characteristics are retained at all operating pressures.

PUMP/MOTORS are made in four sizes, with interchangeable cam rings to widen the range of capacity levels in each size. As pumps, their capacities range from 2.7 to 70 gpm at 2000 psi. As motors, torque capacities range from 13 to 257 pound-inches per 100 psi. PUMP/MOTORS are rugged and compact . . . built for long life under hard, continuous use at 2000 psi . . . they give you *more value per pound* than any vane pump or motor on the market!

Write for Bulletin P-5 today!

The DENISON Engineering Co. 1189 Dublin Road, Columbus 16, Ohio

a *new* concept in OSCILLOGRAPHY

the new DU MONT Type 304-A

The new Du Mont Type 304-A, succeeding the world-famous Type 304-H, is more than simply a new instrument – more than a new combination of established circuits.

It represents a significant development in the science of instrumentation. The Type 304-A is *a true electronic voltmeter.* This reflects a new concept in oscillography. Every feature of the Type 304-A has been evaluated with this concept in mind. All of the features that made the Type 304-H so valuable as a qualitative instrument have been preserved and augmented to enable not only qualitative analyses, *but rapid, accurate quantitative amplitude measurement* as well.

The novel amplitude calibrating system of the Type 304-A permits signal measurements from the screen *directly in volts.* Unlike electro-mechanical devices, the new Type 304-A is not restricted to measurement of sinusoidal signals – or peak-to-peak values of voltage. The Type 304-A may be used to measure any amplitude portion of signals within its performance specifications.

SPECIFICATIONS:

CATHODE-RAY TUBE – New Flat-Face Type 5ADP-

ACCELERATING POTENTIAL – 3000 volts.

Y-AXIS: *Deflection Factor* – Through amplifier, 0.1 p-p volts FULL SCALE (equivalent to 0.025 p-p volt/inch). Direct, 32-39 p-p volts/inch.

Frequency Response – Direct coupling: flat to 0. Down not more than 10% at 100,000 cps. Capacitive Coupling; down not more than 10% at 10 and 100,000 cps. Down not more than 50% at 300,000 cps. Provision for balanced input on 0.1 VOLT-FULL-SCALE range.

Undistorted Deflection – More than 4 inches.
Expansion – Equivalent to 20 inches.

Input Impedance – *Amplifier:* (single ended) 2 megohms 50 $\mu\mu f$; (balanced) 2 megohms, 35 $\mu\mu f$. *Direct:* (single ended) 1.5 megohms, 20 $\mu\mu f$; (balanced) 3 megohms, 20 $\mu\mu f$.

X-AXIS: *Deflection Factor* – Through amplifier, 0.3 p-p volt/in. Direct, 40-50 p-p volt/in.

Frequency Response – Direct coupling: flat to 0. Down not more than 10% at 100,000 cps; down not more than 50% at 300,000 cps. Capacitive coupling: Down not more than 10% at 10 and 100,000 cps. Down not more than 50% at 300,000 cps.

Undistorted Deflection – More than 4 inches.
Expansion equivalent to 30 inches.

Input Impedance – *Amplifier:* 2.2 megohms, 50 $\mu\mu f$. *Direct:* (single ended) 1.5 megohms, 20 $\mu\mu f$; (balanced) 3 megohms, 20 $\mu\mu f$.

LINEAR SWEEPS: *Sweep Frequency* – Recurrent and driven sweeps continuously variable from 2 to 30,000 cps. Maximum sweep-writing-rate, 1"/μsec. Provision for sweeps of extra-long duration; ½ sec. of sweep obtained for each microfarad of external capacitance.

Synchronization – from signal of either polarity.

Sync Limiting – on both driven and recurrent sweeps.

VOLTAGE MEASUREMENT – Squarewave standard applied for calibration by front panel push button.

Voltage Ranges: VOLTS FULL SCALE, 0 to 0.1, 1, 10, 100 volts. MULTIPLIER: x1 to x10
Overall Accuracy: 5%

INTENSITY MODULATION – 15 volts blanks beam at normal intensity settings.

CALIBRATED SCALE – Variable illumination. Numbered calibrations for amplitude measurement.

PRIMARY POWER – 115 or 230 volts, 50-400 cps. 110 watts.

PHYSICAL CHARACTERISTICS – Metal cabinet with grey wrinkle finish. Dimensions: height 13½", width 8¼", depth 19½". Weight 50 lbs.

CALIBRATING the Type 304-A is as simple and easy as zeroing a vacuum-tube voltmeter. Depressing the CALIBRATOR push button on the front panel applies a square wave signal of precisely 0.1 p-p volt to the amplifier. The MULTIPLIER control is then adjusted for full scale deflection (4 inches) so that the peaks are at 0 and 100. Amplitude may now be read directly from the scale where four inches vertically indicate 0.1, 1, 10, or 100 volts, as determined by VOLTS FULL SCALE selector. Depressing the CALIBRATOR push button again, returns signal applied to Y-input terminals to the screen.

The MULTIPLIER control also permits calibration of the scale to other values. For, say, 200 volts-full-scale, the MULTIPLIER control is adjusted near 2 so peaks of squarewave are at zero and 50 on the scale. Amplitude may now be measured directly in volts simply by multiplying the scale reading by the setting of the MULTIPLIER control (2) and the VOLTS FULL SCALE setting (100). Use of the MULTIPLIER control extends the range of the Type 304-A to 1000 volts-full-scale.

DOMESTIC PRICE $333.00

ALLEN B. DU MONT LABORATORIES, INC., INSTRUMENT DIVISION - 1500 MAIN AVENUE, CLIFTON, NEW JERSEY

"I compared them all and chose Servel to Air Condition our plant!"

Make Your Own Point-for-Point Test And Discover Servel's Amazing Extras!

No other installation offers all these amazing features	SERVEL	OTHER
No Compressor—no vibration, quiet, no moving parts to wear.	✓	
Light Floor Loading—no need for special foundation or floor braces.	✓	

No other installation guarantees such lasting performance	SERVEL	OTHER
Pressure Free—refrigerating system operates under a vacuum. Conforms to building codes without extra expense.	✓	
Choice of Energy Source—use present steam source under any pressure . . . or use gas, oil, LP gas, even waste heat.	✓	
Minimum Maintenance—factory guaranteed for five full years.	✓	
Lighter per Ton of Capacity—can even be installed on the roof.	✓	

All-Year Air Conditioner

25-Ton Water Chiller

SELECT SERVEL . . . the air conditioning that offers low operating cost, guaranteed dependability, in residential, commercial or industrial installations.

Servel

AIR CONDITIONING

Made by the makers of the famous Servel Refrigerator

SERVEL, INC. • Evansville 20, Indiana

Get all the facts and you'll get Servel!
Write for complete information today!

Servel, Inc., Dept. ME-9, Evansville 20, Indiana
Gentlemen:
I'm interested in the dependability and low operating cost of Servel Air Conditioning. Send me full details on

☐ Industrial ☐ Commercial Units

*NAME*_____

*FIRM*_____

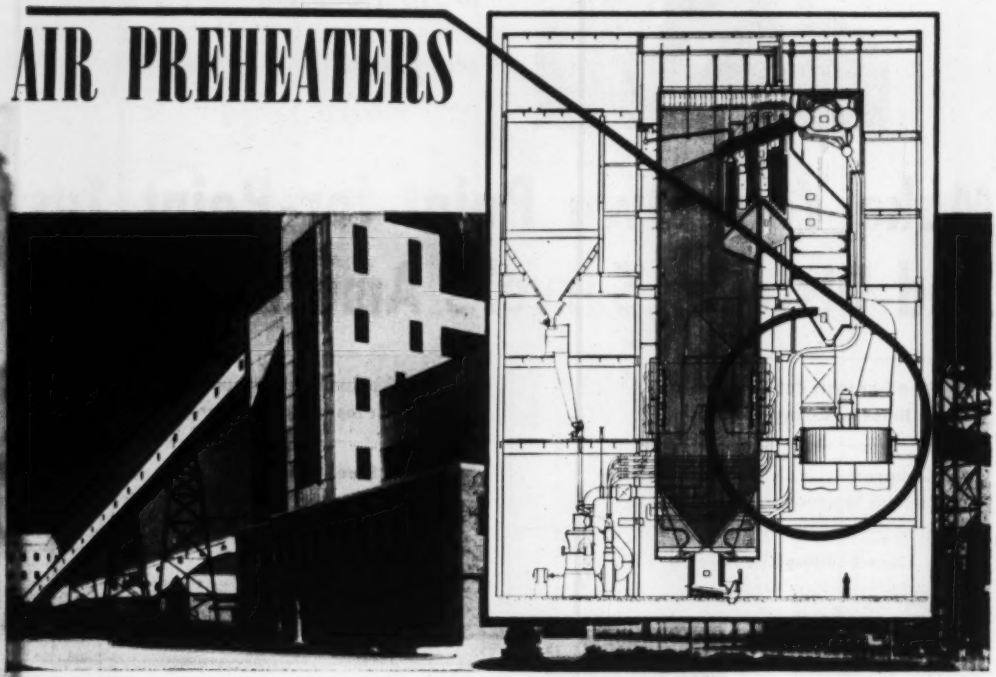
*ADDRESS*_____

*CITY*_____ *ZONE* ____ *STATE*_____

All Boilers at New Plant Yates of the Georgia Power Company

equipped with

LJUNGSTROM AIR PREHEATERS



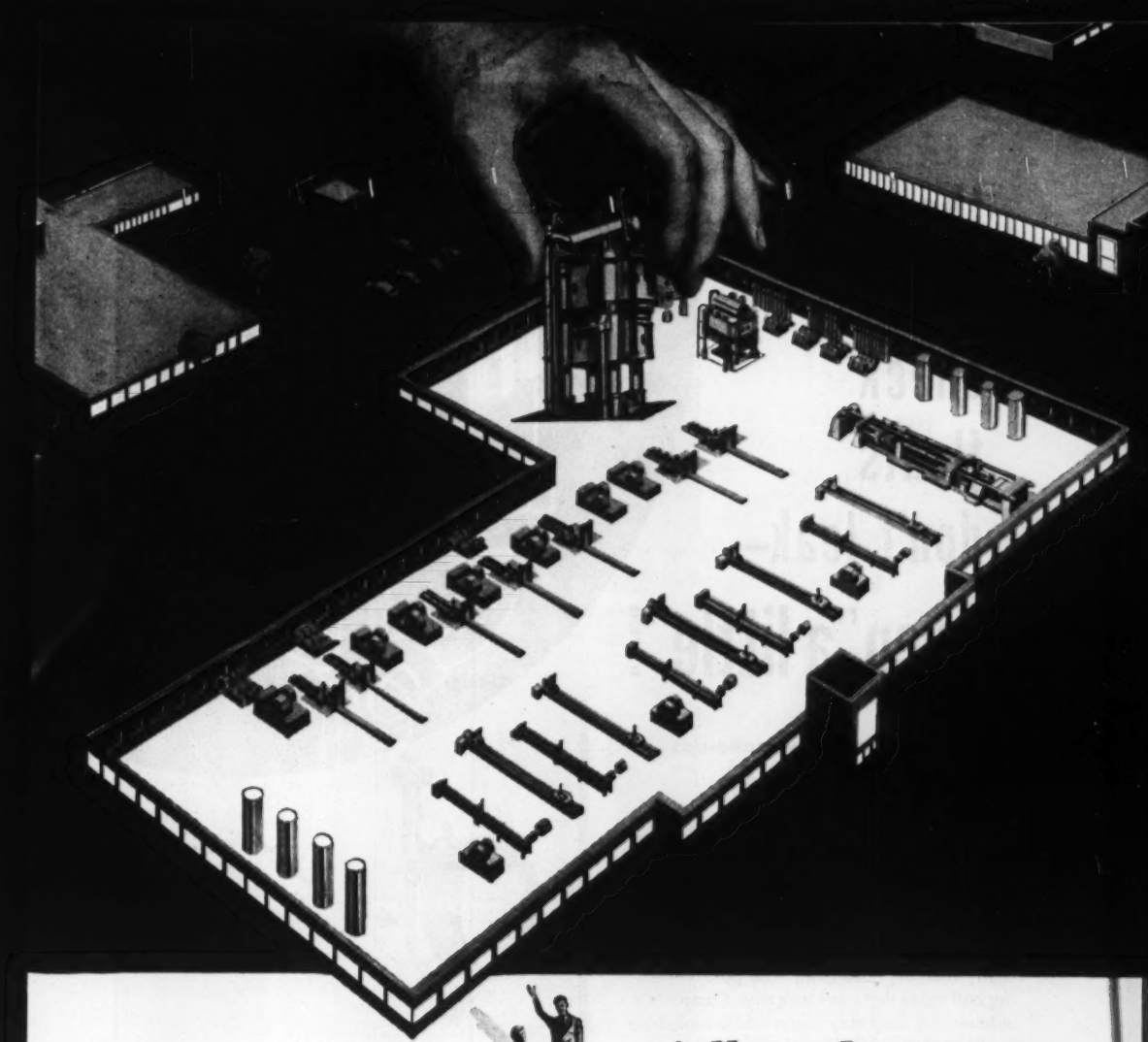
Geared to provide increasing facilities to keep pace with Georgia's growing power demands, Georgia Power Company's new Plant Yates Station is now producing 200,000 kilowatts with a third 100,000 kilowatt unit scheduled to go in service this fall. The station was designed and engineered by Southern Services, Inc., of Birmingham.

Each 100,000-kw turbine-generator in this new plant is powered by a Combustion Engineering—Superheater Steam Generator, designed for pulverized coal firing, and natural gas as an alternate fuel. Each C-E Boiler generates 975,000 pounds of steam per hour at 1325 psi and 950 F.

All of these modern steam generating units have been designed to incorporate two Ljungstrom Air Preheaters. These Ljungstroms are designed to preheat incoming combustion air to 655 F, and cool stack gases to 300 F.

Plant Yates is another example of the widespread acceptance of the Ljungstrom Air Preheater — by boiler manufacturers, consulting engineers, and utilities. Since the war, over 285,000,000 pounds of steam capacity per hour have been designed to incorporate the Ljungstrom . . . another proof that Ljungstrom Air Preheaters are standard equipment for high efficiency steam generating units.

THE Air Preheater Corporation 60 East 42nd St., New York 17, N. Y.



FROM PLANNING *to full-speed operation*

WE DESIGN, BUILD AND EQUIP:

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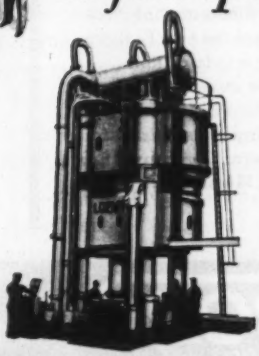

L.C.C. SERVICES

Singly or in any desired Combination

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Planning, Designing and Building of Entire Projects

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Complete Plants Erected and ready to operate

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Re-design and Modernization of Existing Plants

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SUBSIDIARY OF HYDROPRESS INC.

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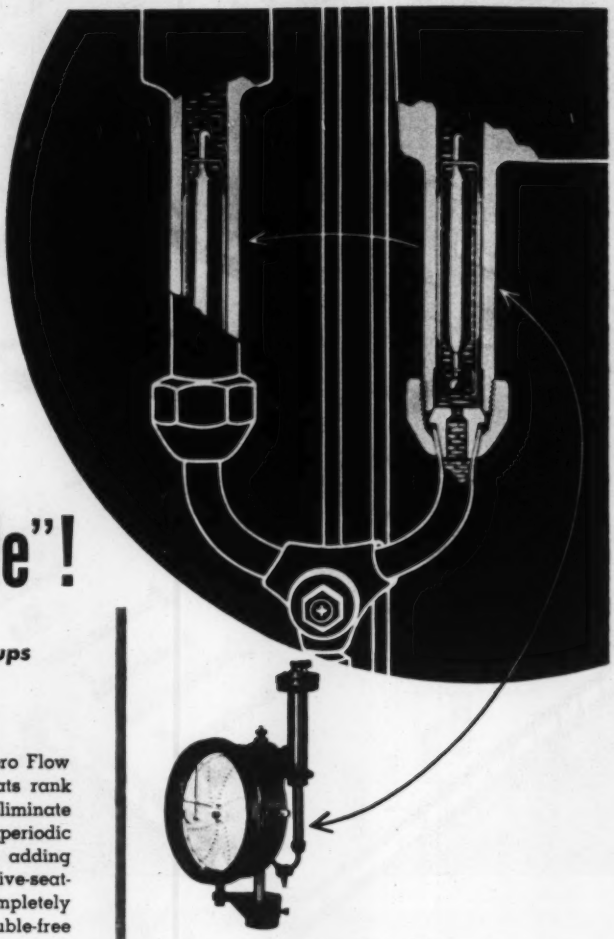
these meter check floats don't leak– not even "a little"!



. . . save mercury make-ups

. . . save re-zeroing

Among the new advances in Foxboro Flow Meters, these Sure-Seal Check Floats rank high in importance. They positively eliminate mercury loss . . . save you from periodic recalibration of the instrument, or adding costly mercury. Designed with positive-seating ball valve that can't lock shut. Completely submerged, they stay clean and trouble-free . . . can't clog or ice. Completely interchangeable.

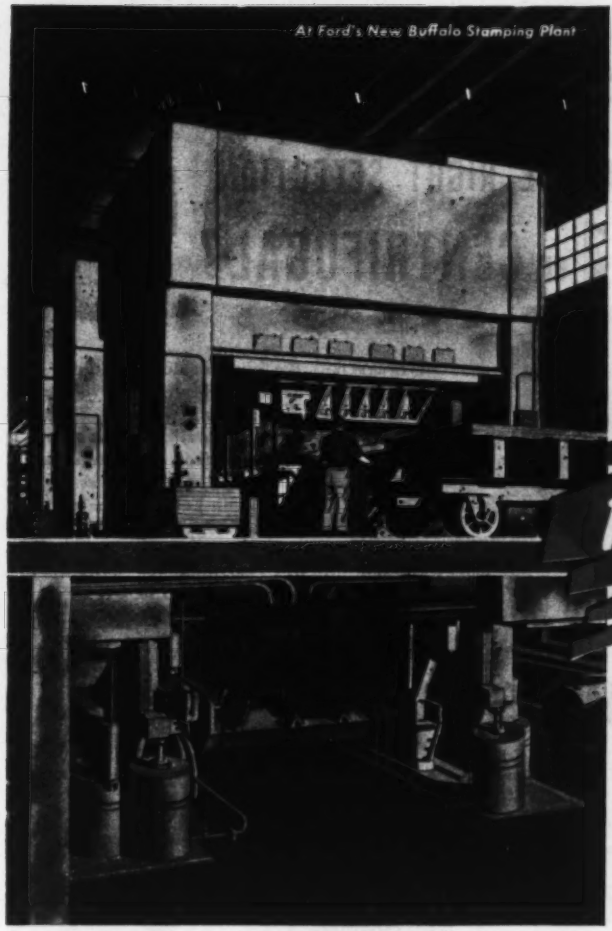
These automatic Check Floats are one more reason why you can operate the new Foxboro Flow Meters for longer periods of time . . . with far less attention. Be sure to check all the advantages that Foxboro Engineers have designed into these instruments. Write for Bulletin 460. **The Foxboro Company, 1829 Neponset Ave., Foxboro, Mass., U.S.A.**

Other New Basic Advances

- **Precision Float Assembly** with stainless steel ball chain and collet-type clamp insures slip-proof, friction-free transmission of float motion to the recording pen.
- **Pressure-Seal Bearing** — stainless steel, with *exclusive seal ring* . . . friction-free and leak-proof at all working pressures. No lubrication required.
- **Union-coupled U-bend** eliminates gaskets; *self-aligning*, all welded construction.
- **Calibrated Damping Plug** fully adjustable under pressure.

FOXBORO REG. U.S. PAT. OFF. *. . . First in FLOW METERS*

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND



One of five huge body presses at Ford Motor Company's Buffalo Stamping Plant with 500-horsepower Reliance adjustable-speed press drive motor.

RELIANCE

Adjustable-speed DIRECT-CONNECTED MOTORS

help set

WORLD PRODUCTION RECORD

on Triple-Action Presses

Adjustable speeds by the Reliance V•S System have answered the challenge of establishing and maintaining record production from mammoth, triple-action automobile body presses at Ford Motor Company's new Buffalo Stamping Plant. Flywheel and clutch are eliminated. Starting, stopping and reversing are accomplished electrically. Adjustable inching speed is available as required from direct-connected, 500-horsepower Reliance motors—the largest ever placed on such presses. Other important advantages of these drives by Reliance include the saving of a substantial amount of steel that was formerly scrapped and a reduction in die replacement costs. Contact your nearest Reliance Sales Representative for further facts on drives engineered by Reliance—for presses or any other type of production machinery.

RELIANCE V★S SYSTEM ®

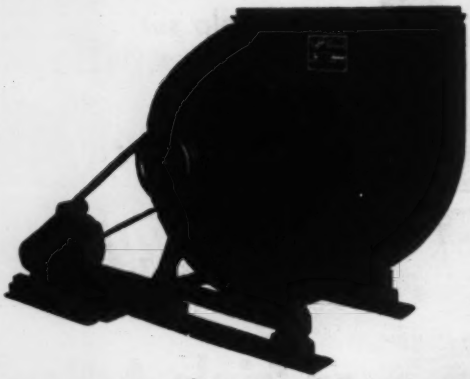
RELIANCE ELECTRIC AND ENGINEERING CO.

1062 Ivanhoe Road, Cleveland 10, Ohio • *Sales Representatives in Principal Cities*

"Buffalo" *Tips on Getting the Best Service from your* **Fans**

MAKING THE RIGHT SELECTION

AXIAL FLOW? or CENTRIFUGAL?



Centrifugal fans like this "Buffalo" Limit-Load model are generally the first choice for large ventilation, exhaust and air conditioning systems. Their efficiency is high even when installation is at a curve in the duct. Medium speed fans, they are ideal for handling large volumes of air quietly at medium pressures. "Buffalo" Limit-Load Fans have the additional advantage of being non-overloading, regardless of the system pressure. For further factors in the selection of a centrifugal fan, write for Bulletin 3737.

"Buffalo" BUILDS BOTH TYPES

Axial Flows, on the other hand, move air by the propeller principle, straight through the fan housing. These fans will thus be most efficient mounted in straight runs of duct. They are ideal for light-duty ventilation and air conditioning service at pressures to around 2". Axial flows are higher velocity fans than centrifugals, are lighter weight and more compact than centrifugal fans, therefore lower cost for duct-mounting on ceilings, walls, etc. However, the performance curve is often the last analysis in your choice of fan for each job. "Buffalo" Bulletin 3533-C contains a comparison performance chart of both "Buffalo" Limit-Load Fans and Axial Flows. A copy will be mailed to you on request.

75

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

148 MORTIMER ST. BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

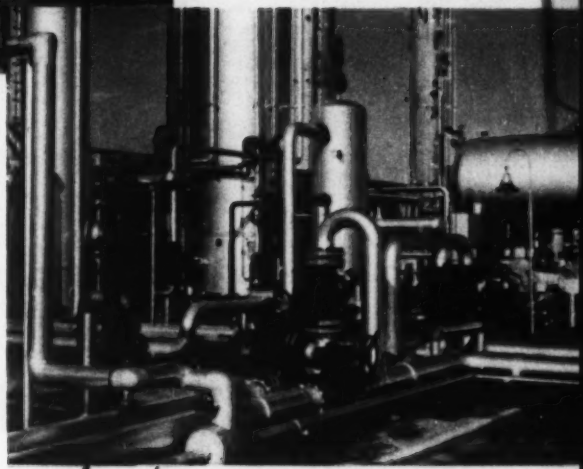
Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

VENTILATING | PRESSURE BLOWING | AIR CLEANING | COOLING | AIR TEMPERING | HEATING | INDUCED DRAFT | FORCED DRAFT | EXHAUSTING

You'll Find Nordstrom Valves ANYWHERE . . . *Everywhere*

FIELD SERVICES

New design Christmas tree in Louisiana oil fields, built with Nordstrom 5,000 lb Hypreseal valves, is typical of Nordstrom field applications. This dual completion tree stands on well, producing from two depths.



PROCESS LINES

In a single process plant you'll likely find a dozen different types of Nordstrom valves. There is a proper Nordstrom valve for nearly any process service. Nordstrom valves in lines shown here are teamed with Rockwell-built Edward forged steel valves.

Rockwell Built
Another Rockwell Product **Nordstrom Valves**

LUBRICANT SEALED TO KEEP UPKEEP DOWN

Anywhere.... **EVERYWHERE**

In gas, petroleum, chemical and general industrial service . . . there's a Nordstrom Valve to do the job.
Rockwell Manufacturing Company,
400 N. Lexington Ave., Pittsburgh 8, Pa.

Plant Protection, A MILLION TIMES OVER

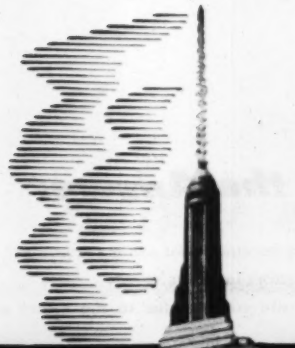
More than five million Nordstrom valves have been installed in gas, petroleum, chemical and other industrial flow lines. Each one is a little additional insurance, an extra unit of plant protection. The record is their best reference.

Rockwell Another Product **Built**
Nordstrom Valves

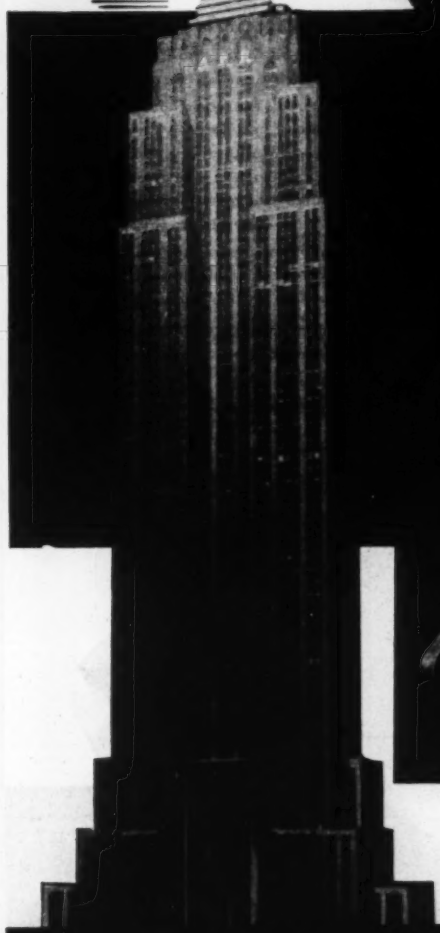
LUBRICANT SEALED TO KEEP UPKEEP DOWN

Air Conditioning

10 STORIES UP!



Quiet operation is all-important when you're conditioning office space 10 stories up (and going higher), as in the Empire State Building. With basement space at a premium, units must be located in conditioned areas. Naturally, noise is taboo. Bush horizontal air handling units provide the silent answer. Why not consider the Bush line in your next air conditioning problem. Catalog No. 425 contains complete specifications. Request copy on letterhead.



Bush Manufacturing Company

If Corrosion is a Problem, "Fastenings by HARPER" is the Answer

Is moisture a problem in the equipment you manufacture?

Are heat and abrasion factors in its life?

Do the fastenings you use corrode due to the action of chemical solutions?

Can fastenings add to the appearance of your product?

If your answer is "Yes" to any of these questions, you should learn more about "Fastenings by Harper."

The H. M. Harper Company is the world's largest exclusive producer of fastenings made of non-corrosive metals—brass, silicon bronze, naval bronze, Monel, nickel, aluminum and all stainless steels. Over 7,000 items are carried in stock. One source of supply assures you better service—one order to write—one account to keep—one bill to pay.

See the Harper distributor near you with stocks ready to fill your order. Consult with Harper metallurgists and engineers on any tough corrosion problem you may be facing.

THE H. M. HARPER COMPANY
8243 Lehigh Avenue, Morton Grove, Illinois

HARPER

SPECIALISTS
IN ALL
NON-CORROSIVE
METALS

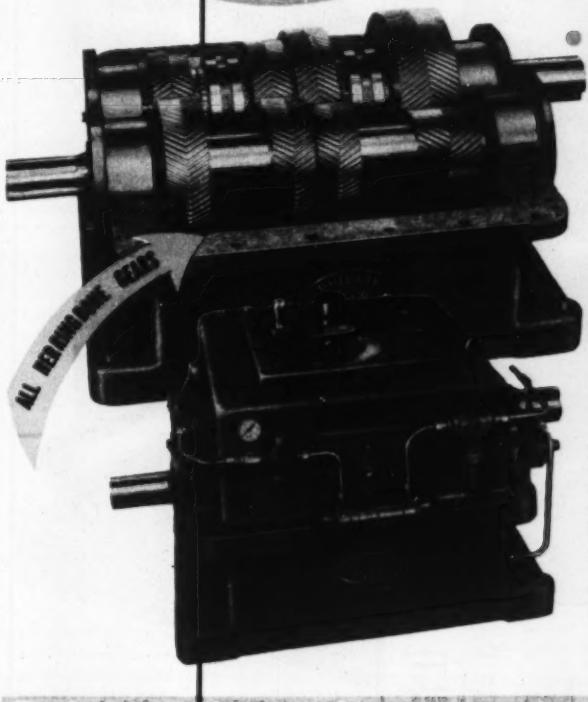
1¼"—7
18-8 Stainless Steel Nut

BRASS • SILICON BRONZE • NAVAL BRONZE • MONEL • ALUMINUM • STAINLESS STEEL

Now Available...

a Change-Speed Unit

- 2, 3 or 4 Speed Combinations
- Wide Range of Ratios
- For Speed Reduction, Speed Increasing, or a combination of both



Industry has long needed a standardized Change Speed Unit, designed and built to *eliminate* the high cost and delayed delivery of *specially built* units.

Philadelphia Gear is now able to offer a line of these units, backed by 20 years of knowledge and experience in the building of Change Speed Units constructed to individual specifications . . . Hundreds of these Units are today in successful operation.

These new Philadelphia Standardized Units are positive, reliable Geared Drives, using Herringbone Gears throughout,—and they provide definite ratios of Speed Reduction, Speed Increasing, or a combination of both. There are no belts to wear out and cause speed variations. They are available for a wide range of horsepowers, and in 2, 3 or 4 Speed Units (photos show a 4 Speed Unit).

A new Catalog CSU-52 illustrates and describes these Units in detail. Send for a copy.

Philadelphia Gear Works, INC.

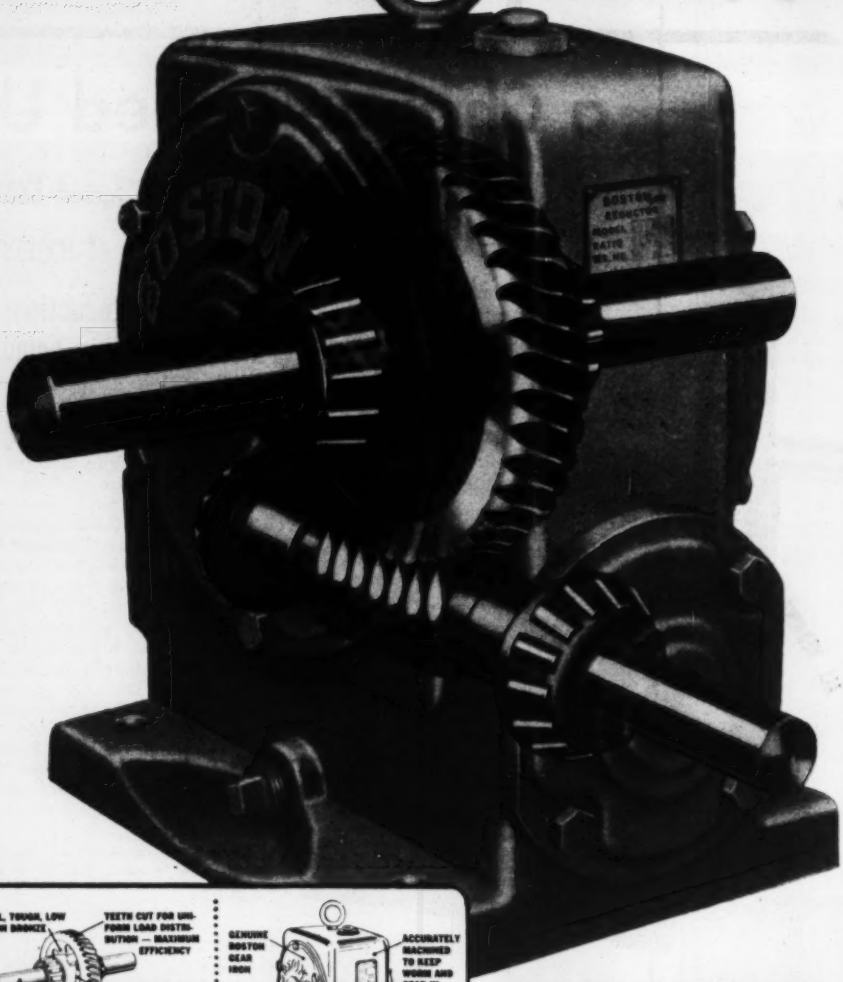
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

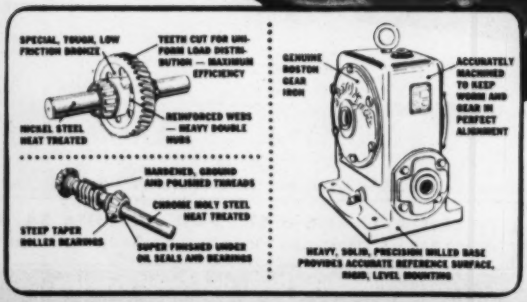
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Sure BOSTON REDUCTORS Cost More

LOOK WHAT YOU GET




SPECIAL, TOUGH, LOW FRICTION BRONZE
TEETH CUT FOR UNIFORM LOAD DISTRIBUTION — MAXIMUM EFFICIENCY
NICKEL STEEL HEAT TREATED
REINFORCED WEBS — HEAVY DOUBLE HUBS
HARDENED, GROUND AND POLISHED THREADS
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STEEP TAPER ROLLER BEARINGS
SUPER FINISHED UNDER OIL SEALS AND BEARINGS
GENUINE BOSTON GEAR IRON
ACCURATELY MACHINED TO KEEP WORM AND GEAR IN PERFECT ALIGNMENT
HEAVY, SOLID, PRECISION MILLED BASE PROVIDES ACCURATE REFERENCE SURFACE, RIGID, LEVEL MOUNTING

The highest efficiency
SPEED REDUCER
by actual test

IRON LUNG Company of America says: "We have used Boston Reductors on all of our respirators since 1936. These standard stock units have driven Iron Lungs over long periods of time, continuously, without breakdown. So long as their high standard of quality and workmanship continues, we shall continue to use Boston Reductors."

IN STOCK NEAR YOU

BOSTON REDUCTORS are ready for instant delivery at any of these Authorized Boston Gear Distributors.

Ask for a comparative demonstration.

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Samuel Harris & Co.
Power Trans. Equip. Co.

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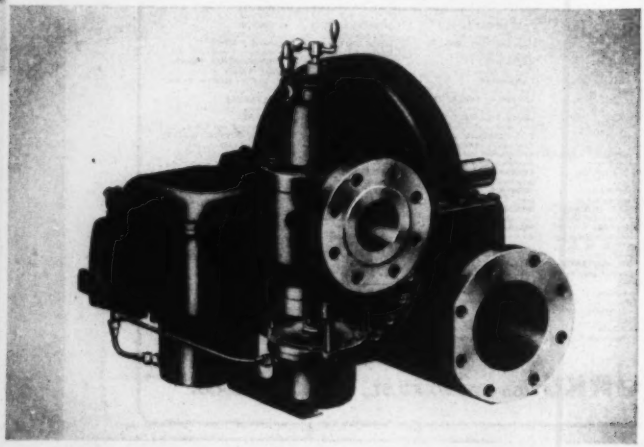
BOSTON GEAR WORKS 66 HAYWARD ST., QUINCY 71, MASS.

Mr. A. Bourgeois, process foreman at Sohio Refinery, adjusts pump valve. Type DP-20, 125 hp turbine increased by 75% the oil thru-put of this pump which supplies crude oil for the distillation unit.



Type DP MECHANICAL-DRIVE TURBINE

This Type DP turbine is one of General Electric's line of mechanical-drive turbines designed for driving pumps, compressors, blowers, etc. Their sturdy construction and many safety features make them ideal for industries having process steam requirements.

At Sohio's Toledo Refinery, this 15 hp, Type DP-16 turbine with non-sparking enclosed overspeed governor, safely pumps propane in an explosive atmosphere.

Mr. Eugene Ten Eyck and Mr. E. J. Bissonnette of Sohio Refinery discuss stocking of interchangeable parts for the Type DP turbines installed at the Refinery.

Sohio Refinery picks G-E turbine drives to increase oil thru-put

Engineers at Sohio's Toledo Refinery installed two G-E mechanical-drive turbines to help eliminate a bottleneck in refinery operations. A General Electric Type DP-20 turbine increased oil thru-put on one pump at Sohio by 75%, when it replaced older drive equipment. Total daily thru-put of the one pump now equals the former capacity of two pumps.

INSTALLED IN HAZARDOUS AREA

Sohio also installed a G-E Type DP-16 turbine in an explosive atmosphere to pump almost pure propane. The enclosed, non-sparking overspeed governor and the positive trip-throttle valve (which shut off all steam flow in case of overspeed) reduce hazards in this area. The turbine, which operates twenty-four hours per day, has required no maintenance during its first year of service.

VIBRATION REDUCED

Replacement of previous drive equipment with a G-E turbine now assures longer life to other machinery in the area. For G-E turbines with their center-line support and rigid assembly of buckets are now contributing to smooth operation at the refinery.

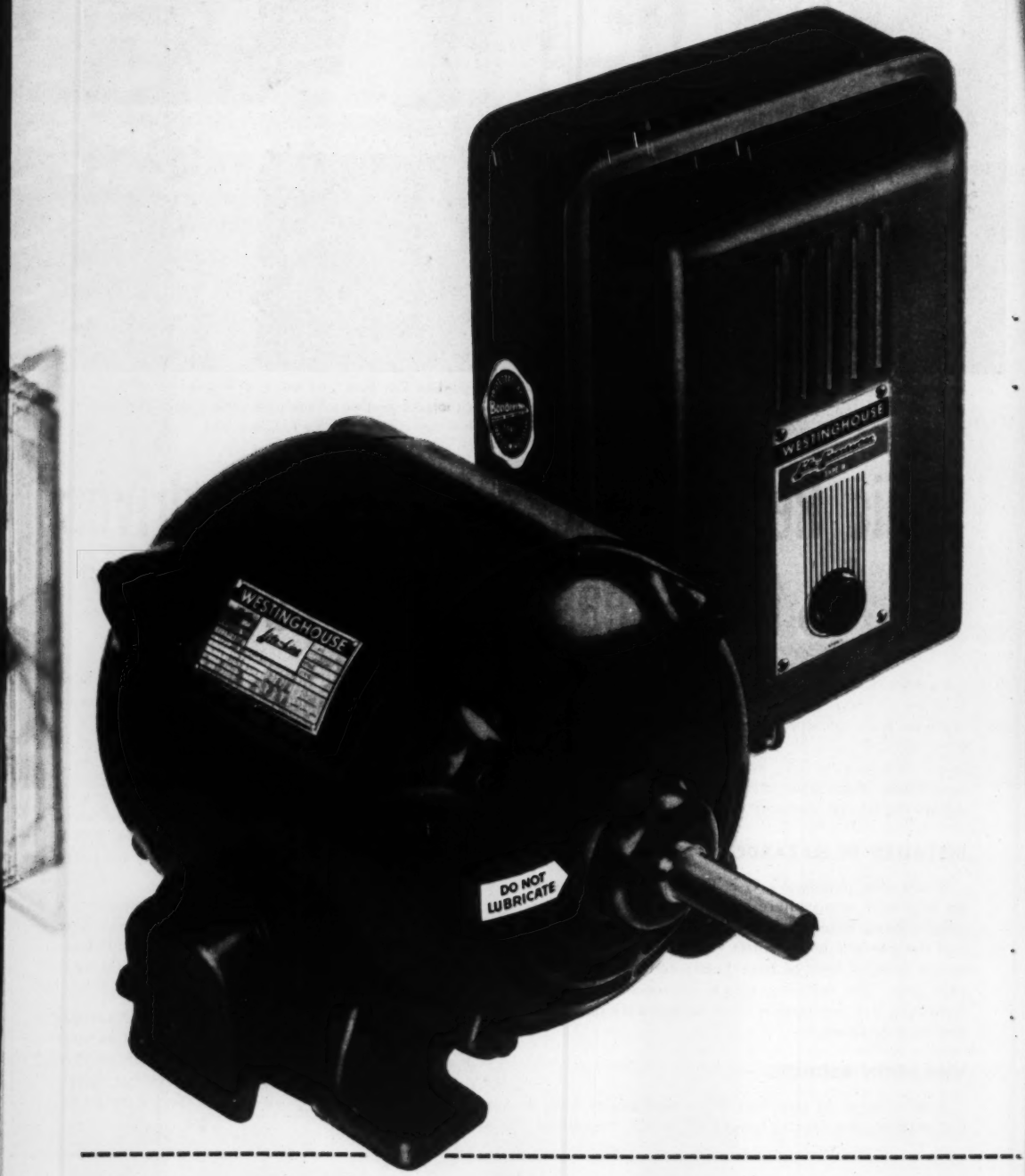
INTERCHANGEABLE PARTS

Use of G-E standard turbines can make stocking of spare parts a simple matter—most replacement parts are interchangeable among various frame sizes of G-E Type DP turbines. Stocking costs are cut, yet parts are available when needed.

This same parts standardization adds to the turbine's flexibility—often the turbine can be adapted to a new plant application with only minor adjustments. Horsepower range can be changed by substituting a different nozzle plate and valve parts.

For more information about the many advantages which these standardized turbines offer, call in your G-E sales-engineer or write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." Section 252-56, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC



WHAT *Life-Lines* REALLY DELIVER IS MORE SERVICE...LESS SERVICING

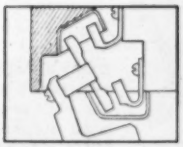
See how the maintenance has been engineered out with modern *Life-Lines*

Forget your previous ideas of motor and control maintenance. The advanced design of Life-Line motors and Life-Linestarters sets new lows in maintenance. Excessive maintenance has been engineered out—in advance.

Take the Life-Linestarter for example: There are fewer moving parts. Operation is simple. No complex linkage in contact closing arrangement. No sliding surfaces. No hinge pins. Contacts, too, are protected by the exclusive deionizing principle of arc extinction—the most efficient method devised. Contact burning is minimized—contact maintenance engineered out!

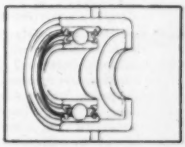
And the Life-Line motor has set new standards for motor manufacturers. Pre-lubricated bearings do away with lubrication maintenance. Heavy structural steel gives new strength . . . provides more torque per pound. New stator slots and insulating material add years of maintenance-free service.

Summed up—what is really engineered and built into Life-Lines is simply—more service on the job—less servicing, and down time. Ask your Westinghouse representative to show you proof that Life-Line motors and Life-Linestarters are the equipment built to match the high productivity requirements of today's industry. A call to your local office will bring you fast service, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21696



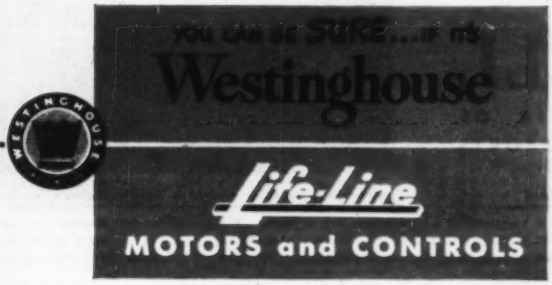
STARTER *Exclusive "De-ion®" Arc Quencher* confines, divides, extinguishes hot arcs fast!

Never Jams. No sliding surfaces to wear—no sticking—no jamming—nothing to wear or replace.



MOTOR *Needs No Lubrication.* Pre-lubricated factory-sealed bearings eliminate troubles due to over or under lubrication, dust and dirt.

Cuts Winding Burnouts. Pear-shaped slot design eliminates pockets. No corner voids remain to collect dirt, moisture.



Main steam piping at Salem Harbor Station of New England Power, 1000° F and 1450 psi, supported by Grinnell Constant Support Hangers.

Problem:

PIPING THAT GROWS...

Solution:

GRINNELL ENGINEERED HANGERS

Eight . . . nine . . . ten inches of thermal deflection! That's not a bit uncommon in today's high temperature, high pressure systems. Very hard-to-come-by, though, is the skill necessary for dealing successfully with suspension problems resulting from *"piping that grows"* . . .

Large manufacturing facilities, expert technicians, and a lot of down-to-earth practical knowledge are needed.

Grinnell is America's No. 1 supplier of pipe hangers and supports, because Grinnell combines modern manufacturing with expert background knowledge gained during a century of piping specialization. Grinnell has developed hangers and supports for *every* piping need, from the simplest to the most complex. Grinnell, and Grinnell alone, can offer these advantages:

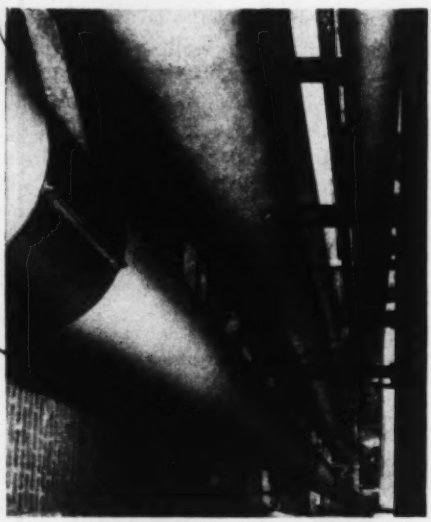
- Complete "start-to-finish" production facilities—including research, design, manufacturing, engineering and field service.
- Practical experience in every type of piping gained during the past 100 years.
- Coast to coast distribution—enabling "out of stock" purchases, anywhere.

Grinnell is always ready to cooperate with engineers and architects in the preparation of pipe suspension specifications. Call Grinnell for pipe hangers and supports.

GRINNELL MODEL L CONSTANT SUPPORTS maintain full safety factor in high temperature, high pressure systems. 3 physical structures accommodate maximum travel requirement of 2½, 5 and 10 inches; 16 sizes collectively cover numerous load ranges between 121 and 19,530 lbs.

GRINNELL PRE-ENGINEERED SPRING HANGERS— maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes. 16 sizes available from stock — load range from 74 lbs. to 9000 lbs.

GRINNELL VIBRATION CONTROL AND SWAY BRACES— dampen vibration, oppose pipe sway and absorb shock. 3 sizes give full deflection forces from 200 to 1800 lbs.; have initial precompressed spring forces from 50 to 450 lbs. respectively.



GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPLIERS

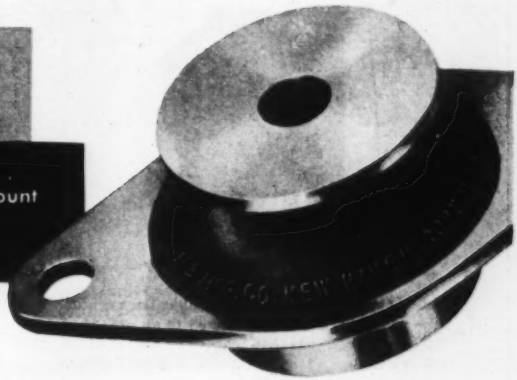
Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Vibration Engineering that solves your problems

PROBLEM: To provide superior vibration control while simplifying suspension design

SOLUTION: The Isomode* Type 5 Mount that isolates all modes of motion



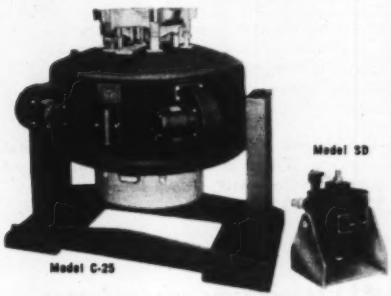
HOW to get optimum isolation into a product design? The answer is not always easy. But it was made much easier to find when Isomode Mounts were developed. They offer what's needed for outstanding results—namely, control of horizontal and rocking motions as well as vertical vibrations.

And here's why. Isomode Mounts have equal spring rates in all directions. They therefore absorb vibrations from all directions equally well. As a result, they can be mounted at any angle, permitting location of ideal suspension points and simplifying design.

In addition, Isomode Mounts have high load capacity in compact size, saving both space and weight. Large rubber volume for their size lends softness for good isolation, yet the mounts are stable, self snubbing and long lasting.

These mounts are an example of the kind of vibration engineering put to work for you at MB. Many companies have found it good practice to make MB their headquarters for vibration information. You will too—on vibration *isolation, control, testing, detection* or *measurement*. For more details on Isomode Mounts, be sure to write for Bulletin 410-4.

*Trade Mark Reg. U.S. Pat. Off.



A vibration exciter to meet your needs

Whether your shake testing requirements are of large order or small, there's an MB Shaker for the job. Model SD, for example, has rated force output of 10 pounds; while the C-25 provides 2500 pounds. Model also available for 10,000 pounds. So if you have to vibration test to MIL-E-5272, be sure to check up with MB. Bulletin No. 1-VE-4 gives technical data on MB Shakers. Write for it.

THE MB MANUFACTURING COMPANY, INC.
1060 STATE STREET, NEW HAVEN 11, CONN.

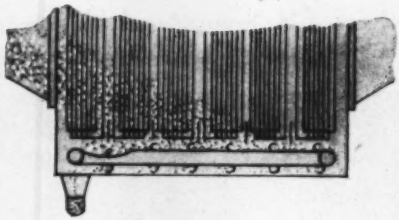
PRODUCTS AND EQUIPMENT TO CONTROL VIBRATION • TO MEASURE IT • TO REPRODUCE IT

Let's be practical about precipitators

1

This Koppers "packaged" mechanical or vacuum tube power pack is not restricted to an area near the precipitator. It can easily be installed in any convenient place in the plant. Result: Compact designs! More flexibility!

2



This Koppers exclusive—the bottom drag scraper—provides continuous dust removal. Cumbersome hoppers are eliminated and dust handling is simplified. Result: Lower operating costs! Less space requirement!

Here are two ways Koppers engineers simplify precipitator operation for you!

PERFORMANCE GUARANTEED!

Koppers engineers protect your investment in an electrostatic precipitator by guaranteeing both the recovery or gas-cleaning *efficiency* and the *residual content* left in the gas after cleaning. Koppers-Elex electrostatic precipitators are designed, engineered, fabricated, erected and guaranteed *under one contract* by Koppers Company, Inc.

IN ADDITION to high efficiency, Koppers concentrates on the practical aspects of electrostatic precipitator design. Shown above are just two of the many practical features which simplify operation.

Besides these compact power packs and the continuous dust removal features, Koppers-Elex electrostatic precipitators may be of the multiple-chamber type. This means one chamber may be shut down for inspection or maintenance without stopping the gas-cleaning action. The dirty gas is simply diverted through other chambers where cleaning continues.

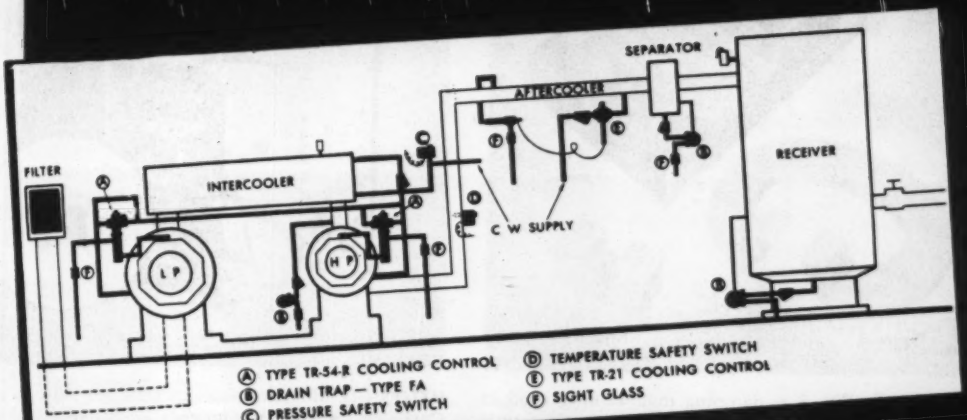
Because rapping is *sectionalized*, re-entrainment is minimized. And because successive collection fields can be separately *energized*, maximum voltage can be applied to each field—with higher gas-cleaning efficiency resulting. Pressure drops are negligible.

IF YOU HAVE A GAS-CLEANING PROBLEM, write and outline the details for us to review. There is no obligation. Just address your letter to: KOPPERS COMPANY, INC., *Precipitator Dept.*, 229 Scott Street, Baltimore 3, Maryland.

KOPPERS®

Koppers-Elex ELECTROSTATIC PRECIPITATORS

AIR COMPRESSOR PROBLEMS...



● Sarco Accessories on Compressed Air Equipment (one of the illustrations in the bulletin)

write for

TECHNICAL BULLETIN 5-CO...

● Sarco type TR-21 Cooling Control on Air Compressor.

● Sarco type FA Float Trap draining separators.

THIS BULLETIN is designed to pass on to you the experience of compressed air users and of SARCO engineers, in improving equipment operation without excessive outlay.

You will find also simple hook-ups of SARCO cooling controls, and of drip traps which eliminate condensation from intercoolers, aftercoolers, separators and receivers.

SARCO SPECIALTIES FOR COMPRESSED AIR include also: ELECTRIC SAFETY CONTROLS to shut down the compressor or sound an alarm when the temperature or pressure gets too high or too low in the cooling, lubricating or air systems; and a complete range of pipe line strainers.

Practical advice on how to improve operation of your air compressor—free in Bulletin TB-5-CO.

359

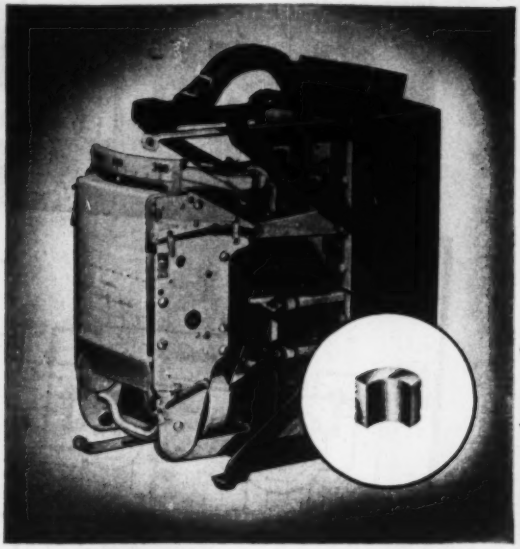
SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N. Y.

SARCO CANADA LTD., TORONTO 8, ONTARIO

REPRESENTED IN PRINCIPAL CITIES

INSTRUMENTS—Fig. A is damping magnet once used in GE indicators. Fig. B is tiny Carboloy magnet now used. It permits smaller indicator design (Fig. C), cuts materials and assembling costs . . . speeds up calibrations.



METERS—In this portable current recorder a Carboloy permanent magnet cuts costs by eliminating power-supplying parts. It also reduces recorder's weight by 10 pounds.

How Carboloy permanent magnets improve electrical products

CONTROLS—Switches in compact Minneapolis-Honeywell controls use permanent magnets to give safer snap action, help quench arcs. The magnets are exceptionally stable; provide uniform high energy for the life of the control.

Want to cut down product size, weight? Build a better-performing product for less money?

Then check the possibility of using Carboloy Alnico permanent magnets wherever you need *lasting* magnetic energy.

Carboloy permanent magnets are simple, self-containing sources of energy that *never* fail. They are powerful in small sizes. Need no outside power supply, no maintenance. They help reduce fabrication costs by eliminating wires, coils and operating parts. Above all, they let you simplify design . . . build a lighter, more compact, finer-performing product at a saving.

On these pages you'll see how others got the jump on competitors by using permanent magnets. Perhaps you'll get an application idea from reading about them.

CARBOLOY SERVICES

If so, check Carboloy magnet engineers for free, expert advice and an assist in design and application. Look to Carboloy production lines, too, for the uniform, high-energy Alnico magnets you'll need for best results — all sizes, all shapes; cast or sintered to your specifications.

Send coupon for free Magnet Design Manual PM-101 and Standard Stock Catalog PM-100.

CARBOLOY

DEPARTMENT OF GENERAL ELECTRIC COMPANY

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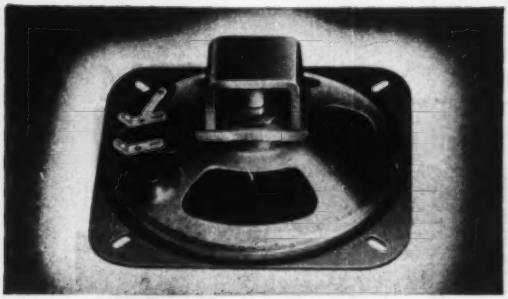
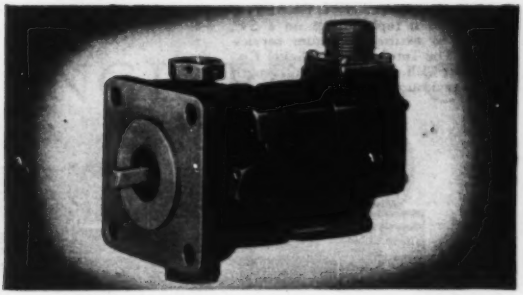
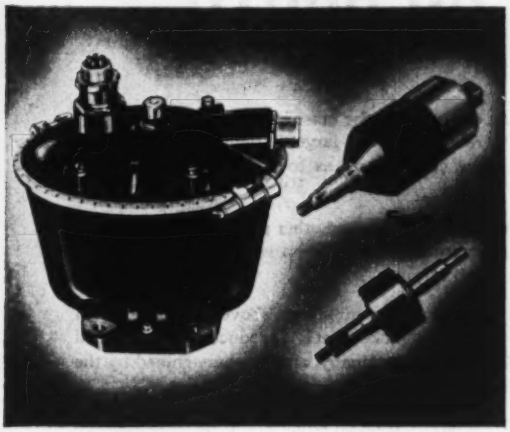


SPEAKERS—In speakers, permanent magnets replace larger electromagnets in field structure. Current passing through Alnico's *uniform* field makes voice coil and cone vibrate in proportion to voltage; tone is truer.



GENERATORS—When GE engineers had only 6" x 6" area for jet's tachometer generator, they whipped design problem with a tiny permanent magnet. It eliminated coils and wires, supplied the powerful energy required.



MAGNETOS—To Scintilla Magneto Division, Bendix Aviation Corp., weight savings are vital in their aircraft products. Fig. A shows chrome rotor weighing approximately 4 lbs. 9 ozs. Fig. B shows newer model rotor using Carboloy Alnico. It weighs only 2 lbs. 4 ozs.

ADVANTAGES OF CARBOLOY PERMANENT MAGNETS

1. Simple — no operating parts
2. Uniformly powerful
3. Permanent source of energy
4. No coils to wire
5. Cool-running
6. No operating costs
7. No power failures
8. Combine electrical and mechanical features
9. Simplify mechanical assemblies
10. Uninterrupted operation
11. Moisture-resistant
12. Create savings

"Carboloy" is the trademark for the products of Carboloy Department of General Electric Company

Plants at Detroit, Michigan; Edmore, Michigan; and Schenectady, New York

CARBOLOY ALNICO PERMANENT MAGNETS

Mail Coupon Today

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Gentlemen:

Please rush me, without cost or obligation, copies of Permanent Magnet Design Manual PM-101 and Standard Stock Catalog PM-100.

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COMPANY NAME_____

ADDRESS_____

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GIANT NICKEL STEEL SHAFT... installed as a replacement on a 54" crusher, to assure maximum service life for The International Nickel Co., at Copper Cliff, Canada. Overall length 21'6", maximum diameter 3'8", bore 6".

How Nickel Helps a Crusher

PUT THE SQUEEZE ON COSTS

Many forgings are so large that only part of the mass can be worked under the press before the steel has to be reheated. These large sections of steel, typified by this crusher shaft, so limit the cooling rate as to make liquid quenching ineffective.

Consequently, improved strength, hardness and other properties that prolong life of large forgings are much more dependent upon wise selection of alloy content than is the case with small forgings.

Because of these facts, the large crusher shaft shown above was forged from a 160,000-pound ingot of 2¾ per cent nickel steel... produced, rough-turned and heat-treated by the Bethlehem Steel Company, and finish-machined by the Traylor Engineering Company of Allentown, Pa.

After normalizing and tempering, two tests on longitudinal specimens, taken from a prolongation at mid-radius, averaged as follows:

Tensile Strength	80,000 p.s.i.
Yield Strength	51,000 p.s.i.
Elong. in 2"	28.0%
Red. of Area	58.3%

The strengthening effect of nickel on ferrite is independent of carbon content or heat treatment of the steel, and its effectiveness in reducing the rate and temperature of the upper transformation, induces better response to the necessarily milder heat treatments used.

Nickel alloy steels may help you obtain peak performance from vital parts of *your* products or equipment. Send us the details of your problems for our suggestions. Write us now.

At present, most of the nickel produced is being diverted to defense. Through application to the appropriate authorities, nickel is obtainable for the production of engineering alloy steels for many end uses in defense and defense supporting industries.

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MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 74 NUMBER 9

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Artist's Conception of an Effective and Economical Helicopter

(*See article in this issue on "Design Proposal for a Military Helicopter," pages 709–715.*)

VOLUME 74
No. 9

MECHANICAL ENGINEERING

SEPTEMBER
1952

GEORGE A. STETSON, *Editor*

Specialization

THE first volume of the Transactions of The American Society of Mechanical Engineers contains an address, "The Field of Mechanical Engineering," which was delivered before formal organization of the Society had been accomplished. The author was Alexander Lyman Holley, a brilliant mechanical engineer, whose death in 1882 was a severe loss to the profession. In this address Mr. Holley discussed the aims of the proposed Society. He spoke about the advantages of personal acquaintanceship among members and the significance which the endorsement of a high quality of elected membership would create. He pointed out the value of writing and discussing papers and how this would result in the collection and diffusion of knowledge.

It is apparent that Mr. Holley vested meetings and papers, and hence publications, with high importance. History has shown that, although they by no means comprise the entire program of the Society, they are still major activities. For nearly three quarters of a century the Transactions of the Society and more recently MECHANICAL ENGINEERING have recorded the writings and discussions which meetings have brought forth and thus have aided in the collection and diffusion of knowledge.

Since the first volume of Transactions was issued, the variety and volume of papers published by the Society have increased greatly. There is little doubt that the thin volumes of the 1880's were read practically from cover to cover by a majority of members of the Society.

Of the Transactions of today it has been said that only a few proofreaders have read every word. A volume of some 1600 pages, each page of which can accommodate more than 1000 words, represents a formidable stint of reading. Few members, if any, have the time or the interest to undertake the task of reading every paper published by the Society today. But as part of the great collection of knowledge these papers are studied when need arises.

The volume of the material published is, of course, only one reason why few engineers today read Transactions completely. The technical literature available in the 1880's was, by today's standards, extremely limited. There were few periodicals and few books as compared with the enormous outpourings of both types today. Even to keep up with the literature of the special field of mechanical engineering in which an individual member is engaged is a task of staggering proportions. Specialization has become necessary, and the number of branches of specialization has increased with the expanding advance of science and technology. To keep pace with this growth of specialization the Society has been forced to modify its organizational structure, the pattern of its meetings, and the character of its publications.

Early in its history The American Society of Mechanical Engineers had to face some important decisions which affected its growth and influence in respect to the collection and diffusion of knowledge and engineering practice. For example, it had to decide what stand it should take in respect to standardization, a term which had broad significance. As everyone knows, standardization became a committee type of activity and was split into several categories.

Material specifications, in general, involved all branches of engineering and to handle this branch of standardization the American Society for Testing Materials was formed, fifty years ago.

Other types of standards involving dimensions and affecting interchangeability of parts in common use—e.g., screw threads, bolts, nuts, tapers—involved the entire industrial economy. Hence the engineering societies reorganized their individual activities in this field by forming the American Engineering Standards Committee, out of which developed the American Standards Association. Standardization activities of the Society today are carried on under the procedures of ASA.

A third great field of standardization in which ASME took an early active interest was the writing of test codes, later supplemented by codes of practice, construction, and operation. The ASME Power Test and Safety Codes and its Boiler Code are examples of this important field of activity.

In all of this standardization activity the ASME developed publications that were quite different from the technical papers written by individuals. For years these codes and standards were published as committee reports in the Transactions; but as the work increased and as it became necessary to provide separate copies of these documents for sale, a new type of Society publication evolved, which vastly increased the contributions to knowledge originally contemplated in the Transactions. Today these and many other types of special publications constitute a great volume of technical material which supplements the individual papers issued in Transactions and MECHANICAL ENGINEERING. Mr. Holley's aim of writing and discussing papers and collecting and diffusing knowledge has indeed resulted in a vast and varied program of publications.

But specialization and the progress of engineering de-

velopments forced other changes in Society organization. In his inaugural address as first president of ASME, Robert Henry Thurston said "the matter of shop management is of equal importance with that of engineering," and a few years later the Society decided that it could properly discuss subjects in that field. A counterproposal, not then adopted, was the formation of a separate section of the Society to develop the field of shop management. A quarter of a century later special interest in the field of gas power resulted in the formation of a gas-power section within the Society. In the meantime various groups of specialists organized technical societies representing limited areas of the general field of mechanical engineering, and the growth of specialization in new fields was becoming rapid. Hence ASME organized its technical interests into a number of professional divisions, each one of which was, in effect, a society within the Society. These divisions, each with an executive committee, took on the task of formulating the technical programs of the Society meetings and, in some cases, instituted meetings, or conferences, and publications of their own. Today specialization within the Society continues and the number of divisions gradually increases, but the result continues to be the collection and diffusion of knowledge.

With all of this growth of specialization and membership, the meeting pattern of the Society had to be modified also. In the early years the Society met as a single group over which the president himself presided. Every member present listened to the presentation and discussion of the technical papers and reports. At an Annual Meeting of today, as many as eight professional divisions may be holding sessions simultaneously. A member chooses whether to listen to a paper relating to his own field of specialization or to find out what is being discussed by some other group of specialists. Because Society meeting programs are limited as to the number of separate sessions they can accommodate at any one time, many divisions also hold conferences of their own at some convenient location and are thus able to offer their members a much greater number of technical papers dealing with their specialties. These changes in Society meetings procedure certainly enhance the value set by Mr. Holley on the writing and discussion of papers, but the individual member no longer finds it possible to listen to the presentation and discussion of the entire program of papers. The chances are he learns more about his own field of specialization and less about other, even related, fields.

Specialization in engineering societies is inevitable and useful but it also has its disadvantages and inefficiencies. One can imagine, for example, what would happen if every ASME professional division became a separate and autonomous society. No detailed enumeration of these disadvantages will be attempted. They have been recognized ever since ASME itself was organized and have created almost continuous attempts in an opposite direction—the formation of an over-all engineering society which would take over the fields of common interest of all engineers and all engineering societies. To date several types of organizations to effect this over-all consolidation have been proposed and some have been organized, while other types, of which Engineers Joint Council and Engineers' Council for Professional Development are examples, afford opportunity for joint intersociety action with a minimum staff and operating expense.

In so far as the field of mechanical engineering is concerned, developments in ASME procedures abundantly satisfy Mr. Holley's aims for the Society. Never before in its history has ASME collected and diffused so much knowledge or stimulated the writing and discussion of so many papers. Never before has the prestige of the Society been so generally recognized as an endorsement of the high quality of its elected membership. Never before have the advantages of personal acquaintanceship among the members been so numerous or so easy to enjoy. But the question is sometimes asked: Does the individual member, concerned as he appears to be with a specialization within the field of mechanical engineering, reap as richly and as widely in that field as he did when conditions brought him in contact with the interests of all the members? What provision is made to keep him up to date on progress in specialties other than his own?

The individual member who has an opportunity to attend Society meetings may, of course, shop around among the many technical sessions listed on the program and attend some of those not related to his own field of specialization. He may subscribe to ASME Transactions and, even if he cannot read all the papers outside his own field, he can at least familiarize himself with what other groups of specialists are writing and talking about. Except in relatively few cases these methods are probably not followed although they would yield valuable returns, particularly to recent graduates whose field of specialization may not be set for several years.

The one ASME publication which is designed to give every member an opportunity to keep in touch with a variety of special fields is MECHANICAL ENGINEERING. It aims at breadth and variety of subject matter. It aims also at stimulating interest in many fields with the hope that it may aid in the crossfertilization of ideas from one field to another.

In the calendar year 1951, MECHANICAL ENGINEERING carried 84 full-length papers. Of these, 51 were contributed by 15 professional divisions; 11 by 6 committees; 6 were addresses at ASME meetings on a variety of subjects; 3 came from ASME Sections; 3 dealt with Society affairs; and 3 with activities of joint bodies, EJC and ECPD. Seven came from other sources. In addition, two departments, Briefing the Record and ASME Technical Digest, contained a great variety of technical and general information. There were book reviews and book notes and a news section devoted to Society affairs.

Every member of ASME receives this magazine. He will not find in it a concentration of material dealing with the field of specialization in which he works but by means of it he can keep posted on what his Society is doing and some of the developments that are taking place in other fields of specialization. For it aims to be effective as a general-interest magazine in aiding in the collection and diffusion of knowledge.

PRESENT ARMY CARGO HELICOPTER HAVING MONOCOQUE CONSTRUCTION WITH STANDARD AIRCRAFT FITTINGS AND TRAPPINGS

DESIGN PROPOSAL *for a* MILITARY HELICOPTER

By WILLIAM B. BUNKER

COLONEL, TRANSPORTATION CORPS, U. S. ARMY, WASHINGTON, D. C. MEMBER ASME

INTRODUCTION

HELICOPTERS are designed to play an important part in Army operations of the future. The outstanding success with which the small, two-passenger versions have evacuated many thousands of casualties from the battle area in Korea has given a hint of the tremendous capabilities for increasing the tactical mobility of ground troops that the ten- to twenty-passenger models now coming off the production line will offer. Military leaders have been unanimous in their enthusiasm for this development and have predicted a very broad application of the helicopter to the military field. As the first step, several cargo helicopter operating units have been formed in the Army and they are now being deployed to field Armies for development and test of the doctrine and techniques for their employment. These companies, if they live up to expectations for them, are but the early pioneers of what ultimately will be a considerable force in the Army of the future.

As we are making plans, however, it does not seem that everyone in the program is working with the same objective in view. The Army requires helicopters primarily to improve its tactical mobility; our strategic mobility, which places heavy reliance on the long-range transports of the Air Force and the new fast troopships of the Navy, is already quite superior to that of any Army in history. Tactical mobility, probably best illustrated in the Panzer concept of the German Army, relies on fast-moving motor vehicles which have a high degree of cross-country ability. Improvements in tactical mobility of ground forces since World War I have beeen tremendous, and a glance at the number of motor vehicles in our modern divisions would lead to the impression that practically all possible improvement in this direction already has been made. But all of these developments have failed to do more than aggravate one of the greatest foes of Army mobility—mud.

Horses of the old cavalry fared better in mud and snow than do the modern tanks and trucks which have replaced them. It is here that the helicopter has come to look to us as an even greater improvement to our battlefield situation than the invention of the motor vehicle—we can be free of the ever-increasing road and bridge-building problems generated by our heavier and heavier vehicles. In keeping with this concept we are inclined to view the helicopter as a supercolossal "Hollywoodish" truck.

In many sectors, however, conversation seems to revolve around features like higher and higher speeds, blind-flying instrumentation, better radio and navigation equipment, longer ranges, and similar factors which will make the helicopter more nearly competitive to fixed-wing transports. The only real advantage which a helicopter has over a conventional aircraft is its ability to land and take off without a ground run; and against this must be balanced its slower speed, greater horsepower requirement, increased mechanical complexity, and higher cost. Certainly no one can say that this score is balanced and most will go even further and surmise that the helicopter is as poor an airplane as it is a superior truck. It is therefore proposed in this paper to lay down the general framework of a

NOTE: Statements and opinions advanced in this paper are to be understood as individual expressions of the author and not those of the Department of Defense or the Transportation Corps.

satisfactory Army helicopter from the worm's-eye view in an effort to counter some of the developments of late which seem to be evolving a machine which in many respects is less instead of more satisfactory for our purposes.

DESIGN OBJECTIVES

Economy. The first objective in the design of any military equipment should be economy. Since our equipment represents essentially nonproductive devices whose value can never be recovered from earnings, it is important that its costs be kept as low as possible. Our country not only is engaged in an unprecedented arming program of its own but also is trying to equip the armies of all its allies, and it is essential that we do not defeat our objective of national sovereignty by dissipating our wealth completely while trying to build our strength. A continuing effort must be exerted to make our military equipment as economical as possible within the limits imposed by its mission.

In designing military equipment the first objective usually has been to make it superior in all possible ways to anything which the enemy has or is capable of producing. While this is a laudable objective, it usually has resulted in very expensive refinements to our materiél whose additional capabilities are of limited application. Since the helicopter is essentially a supporting device rather than a primary weapon, emphasis on its economy is believed to be sound.

Therefore we must produce a helicopter design which will have as low a first cost as possible. Present machines are liquidating the expenditure of many millions of dollars worth of design, tooling, and plant-expansion costs and we all realize that many of these expenses are not necessarily repetitive. Even after these costs are eliminated, however, present estimates by manufacturers and others place the mass-production costs of cargo helicopters at $30 to $40 per lb of airframe weight which is considerably higher than that of fixed-wing transports. On the other hand, if the helicopter is in fact a truck, its initial cost, measured on a basis of its ton-mile life expectancy, should be in the same order of magnitude as a truck and not 20 or more times that figure as at present. These costs can be tapered down by three major approaches: Improving production methods, decreasing special luxury-type items of equipment, and simplification of design. All of our present-day helicopters appear to be susceptible to a great deal of improvements under all three of these counts. Since Army equipment is procured in large quantities and usually in a hurry and since its actual time of employment is usually relatively short, it is felt that first cost is the essential measure of economy and that high-quality and long-life considerations which are sometimes paramount in commercial designs are of secondary importance in this problem.

Of course economy also must be reflected in operating costs. The elements to be considered here include fuel and lubricants, spare parts, and crewing requirements. In this phase, all of the cost elements must be considered simultaneously and, in applying the factors to military operations, the cost of fuel and supplies delivered to the point of actual operations is important. A further importance of the fuel requirement, over and above its obvious dollars-and-cents significance, will be appreciated when it is realized that the fuel requirements of our modern-day military machine are getting so great that some authorities are questioning our ability to flex our muscles fully after they are built up.

Ease of Maintenance. As the second design objective I have taken ease of maintenance. While designers and manufacturers have taken vigorous action in this field in the past year, there is still room for vast improvement. A request to use helicopters in a particular area today is usually refused not on the ground that they would not be useful but because they cannot be kept operational without an inordinate amount of maintenance support. As features are modified to make the helicopter more dependable and trouble-free, additional equipment and devices have been installed that only a mental giant can adjust or a physical one handle. Again I point out that the helicopter is an Army truck and its maintenance requirements must approach the standards of that type vehicle.

The first requirement for ease of maintenance is simplicity. Manpower available to the military services cannot be expected to be of more than average quality and, as the number of helicopters in use increases the standards of the available maintenance personnel will decrease. Further, in military operations, all maintenance personnel operates in the field in remote areas and under primitive conditions—there is little similarity here to the well-equipped, lighted, and heated shops enjoyed by the manufacturer. Therefore a high degree of availability and hence low amortized cost will depend on the ability to perform our necessary maintenance operations as rapidly and easily as possible with a minimum of special equipment and with mechanics of no more than average ability.

The helicopter in the military service is an instrument of opportunity. The requirement for its service normally will arise rather unexpectedly and may continue for long periods. It is therefore essential that a maximum proportion of the machines be capable of flying at all times and that they be kept in service with a minimum loss of time for mechanical processing. The standards of service of the helicopter in the combat area must approach that of other military equipment where local tactical situations often demand a slighting of recommended maintenance practices. We cannot expect the enemy to hold up his activities when it is time to conduct our service inspections on our helicopters.

The combat-zone helicopter also should have as low a parts-consumption factor as possible. While it is advantageous in some respects to solve the maintenance problem by exchanging major assemblies and this system is recommended in forward areas, it is also essential that the supply of these assemblies does not generate an even greater problem. A small part which has cost only a dollar at the manufacturer's plant has accumulated several times that amount in handling charges by the time it reaches the forward areas. Current experience indicates a spare-part requirement of one half the value of the machine which not only increases its costs but also reduces the production capacity usually in the most vital areas of the industries.

Producibility. Since military requirements usually are held in abeyance in normal times and then frantically expedited when emergencies arise, another important objective of our design must be producibility. In our effort to get better and better equipment in the hands of our fighting men this is an objective which has been honored more in breach than in compliance. As a result our vaunted production capacity is even now suffering pangs of technological hunger while we have production capacity and labor to spare and our urgent rearmament program falls progressively further behind. The helicopters of today are mainly "improvements" on original designs produced by engineers who were concerned primarily with developing an aircraft which would hover and take off vertically with a given payload. Changes to make the aircraft cheaper, simpler, and easier to produce with less highly skilled labor have been a minimum. Tolerances on blade fittings, fuselage members, gear teeth, and thousands of other components indicate a complete disregard of the basic principles of mass-production design which have been established in the automotive and other industries.

As the first step under this objective it therefore seems that

THE FUSELAGE FOR THIS HELICOPTER COST ABOUT THE SAME AMOUNT AS TO CONSTRUCT A 12-ROOM HOUSE

the helicopter manufacturers should accent their production-engineering staffs. These fields today seem to be dominated by the converts from the air industry which has never been particularly noted for cost-consciousness. A checkrein is needed on aircraft designers who set up requirements for manufacturing procedures which multiply costs severalfold usually in the hope of saving weight; if the helicopter could be made half as expensive to build and maintain, the requirement to exact the last ounce of lift from the available horsepower might well be relaxed. When the large helicopter requirement materializes, as it surely must, there must be a design available which can be mass-produced in the maximum number of plants with the minimum use of highly trained special skills. A production-engineering study by a mechanical designer from the automotive field should be able to eliminate a great portion of the items requiring uneconomical manufacturing processes which now are found on all helicopters.

The sudden upsurge in requirements for helicopters will come when the greatest requirement also will arise for all-out production of all types of fixed-wing aircraft. This situation dictates the requirement for the minimum competition between the helicopter and aircraft industries—and here I advisedly have excluded the helicopter from the "aircraft" category. The helicopter of today is basically a conventional airplane fuselage which has been distorted to carry a rotor or two and to eliminate the wings; in fact, one manufacturer has admitted that his newest fuselage was traced from drawings of an airliner and most of the others give the appearance at least of having employed the same technique. But since the stresses, speed, and other characteristics of a helicopter are so different from those of a conventional air transport there appears to be no valid reason for this practice unless here, too, we are trying to make an airplane out of a helicopter. Other than the requirement for minimum fuselage weight, there is little relationship between the two requirements—at 80 mph, streamlining is a minor problem and it becomes less so when we consider that the helicopter may be required to fly sidewise, nose up or down or in almost any other conceivable attitude—nobody feels impelled to try to streamline a brick. When it is appreciated that the small fuselage of a four-passenger helicopter, currently under production, costs more than a twelve-room mansion and involves many more complex tools and skills, the incentive to remove its manufacture from this field becomes tremendous.

Performance. Another and possibly a minor objective of our new design should be performance up to its stated capabilities. Helicopter enthusiasts and boosters as well as the advertising and sales departments seem determined to claim the very last ounce of performance for their craft. As a result, most machines, while flying and hovering and autorotating as a normal helicopter is supposed to do, have to be adjudged unsatisfactory because they will not lift the 2100 or 4500 lb claimed for them in the specifications. While no one is particularly surprised when a new soap does not get him elected mayor or a new cigarette fails to make him sing like an opera star, the users of helicopters seem to take this disillusionment rather hard. Recognizing that the helicopter will probably never be exploited under its ideal operating conditions, that most parts of the world in which we are interested are not at sea level, and that designers are all incurable optimists, it is urged that the characteristics of all helicopters be expressed in terms of what they will do under the usually encountered conditions rather than at the unattainable "normal." Then when we say that we can lift four people, we know that we won't have to leave two behind because it is a warm day and a few minor adjustments on our craft are not perfect. Our Army trucks are always overloaded—and the state-highway inspectors

often feel that all vehicles are —and we have allowed for it by designating our military truck a $2^1/_2$-ton vehicle, when normally it will carry 5 tons without difficulty or damage. I do not propose that the helicopter's capacity should be understated by such a wide margin but on the other hand I don't want to go to sea level on a rare day in June in order to be able to carry the advertised load. Since the helicopter is built to serve the Army, its specifications should be in terms with which Army people are familiar.

DESIGN PARAMETERS

Having established our design objectives, we shall next consider the general criteria which will serve as parameters for our optimum design. There is, of course, room for a considerable amount of personal opinion when we approach any problem as empirical as this. Since our experience to date has been confined largely to that gained with two-place aircraft operated on rather limited missions and since the developments of warfare are highly unpredictable, a long-range extrapolation of experience and background is required. It does not appear however that moderate variations in these features should completely invalidate the conclusions.

Pay Load. It seems appropriate first to develop the pay load requirement for the helicopter we are seeking. It is realized, of course, that there are many variables and here, as elsewhere, the answer could be the stock phrase of the Army's General Staff College, "It all depends on the situation." I think it is obvious that the larger the helicopter the more it will carry per trip and hence the more it will produce ton-mile-wise per day of operation. Also, the larger the helicopter the more different types of equipment it can carry. On the other hand, the larger the unit, the greater will be its crew requirements and the higher its initial cost and consequently the greater the loss when it is damaged. Maintenance in the field without overhead cranes and other special equipment will also present formidable problems on the super-helicopter. Size has the further disadvantage of decreasing the flexibility of the vehicle as it is increased. All transportation equipment has experienced this phenomenon to a greater or less degree. We have built ships too large to serve the ports where trade was available, boxcars too large to be filled by our customers and, I think, in some of our new designs, airplanes too large for all but the choicest routes. It is true that the operating costs of helicopters probably can be decreased as their size is increased above those now in use but this factor appears now to reach the point of diminishing returns in the region of twenty to twenty-five passengers at the present state of the art.

Since most military cargo is packaged for manhandling, particularly that, such as rations and ammunition, most likely to rate a helicopter ride, it would seem sound to base the lift requirement on the more important items of equipment needed by the forward elements. The minimum equipment lift which seems desirable to establish appears to be the 105-mm howitzer which weighs 5200 lb and its prime mover at 5900 lb; other vital equipment all weighs less than these two items. In view of the wide availability of the $2^1/_2$-ton truck in the combat zone and the fact that, if a unit is being supported by helicopters it probably can subsist indefinitely with its small command vehicles in lieu of a cargo truck, these facts would lead us to establish a weight-lifting requirement for a military cargo transport of 6000 lb. With such a capacity, this helicopter would be able to carry twenty fully equipped combat troops or an equal number of patients in litters. Two transportation helicopter companies, each equipped with twenty-one helicopters of this size, would be able to keep a complete infantry division in active combat supplied over a 35-mile range, while a three-company battalion would be able to transport an entire infantry battalion combat team in one lift.

A machine of this size will have a wide field of application to the tactical, logistical, and other missions which we envision for our helicopters. On the other hand, since the helicopter is an ideal vehicle for by-passing the omnipresent destroyed bridges and road blocks of the battle area, we will need some larger machines capable of lifting our heavier vehicles and equipment across or around these obstacles. Here the 20,000 to 25,000-lb lift which will carry a loaded cargo truck and most of our other items seem a good size. For movement of small patrols to isolated hilltops, transporting signal installations, forward-area evacuation, and other missions where our optimum helicopter is too large or not agile enough, we also will require some of the smaller size. In this field it seems that the 1500 to 2000-lb lift of the present cargo helicopters should be satisfactory, although a minimum capability of 2500 lb in order that it be able to transport the ubiquitous jeep might be desirable. And of course there always will be a requirement for a small observation-liaison vehicle for the million and one odd jobs in which the helicopter already has proved itself. Here the capacity should be at least 1000 lb to avoid our present difficulty of always operating overloaded and to permit a commander to be accompanied by at least two members of his staff on his liaison and reconnaissance mission.

Within this pattern of sizes it is felt that at least 75 per cent of our helicopters should be of normal 6000-lb size; 10 per cent of the heavy-lift 20,000-lb variety; 12 per cent of the smaller one-ton type and 3 per cent of the utility class. It is realized that the optimum size is smaller than that which usually has been considered in the past but, to labor our simile further, it can be seen that this capacity is the same as that of the truck we are replacing.

Range. The range requirement for the Army helicopter is somewhat easier to establish and should be less controversial. The recent memorandum of understanding between the Secretaries of the Army and the Air Force established that the major role of application of the Army cargo helicopter is in transportation of Army units, equipment, and cargo within the combat zone. (Here again is the concept of the helicopter as an Army truck rather than as an Air Force transport.) The combat zone was described in that same paper as normally 75 miles or less in depth and, while in Korea that distance is well over 200 miles, the lesser figure can be considered as true in a normal situation. Assuming that the dump containing the supplies is not directly behind the unit in front requiring them, it then seems logical to assume that the maximum distance between points in a normal situation will be approximately 100 miles, or that the Army cargo helicopter should have a range of 200 miles. Since the helicopter represents a premium means of transportation, this link in the chain should be kept as short as possible. Therefore we can expect that the average helicopter mission will be somewhat less than the 200 miles just developed.

Helicopter operations of the Marines in Korea normally have been over an average operating radius of 20 miles or less but these operations have taken place since the situation there became relatively static. Based on all these considerations, it then may be assumed that the Army helicopter's normal mission will be to carry its load 30 miles, to discharge and return empty or with a partial load of casualties—it has been experienced that any unit being supplied by aircraft normally will have much more return lift than will be required by its medical evacuation needs. Therefore it can be concluded that we should seek an aircraft whose operation on this normal 30-mile mission is the most economical and which will have the capacity of carrying the lift developed previously for 100 miles

with an empty or nearly empty return trip, at some decrease in efficiency if necessary.

Speed. It is in endeavoring to establish speed criteria that we must be particularly cautious. In designing transportation equipment, engineers always have sought to make the speed of each new vehicle more than that of its predecessor. It is true that the ton-mile capacity of a vehicle is directly increased as its speed is increased and that one of the big advantages of the helicopter over the truck lies in its higher operational velocity. On the other hand it is equally true that speed is a very expensive commodity, and it is not attained without sacrifice in other characteristics, particularly first cost, airframe weight, and economy of operation. Hence it is apparent that in establishing the speed requirement for our vehicle, we should in the interest of economy accept the minimum high speed which will accomplish our mission.

In setting our speed objective it is well to re-emphasize that we are seeking a replacement for the army truck. Here where roads have usually been damaged by military action, are subject to enemy fire, and generally suffer from inadequate maintenance, our speed of movement in conventional vehicles has averaged about 10 mph. The normal cruising speed of helicopters as now designed offers approximately a tenfold increase in our mobility without the requirement of special "high-speed" designs—already a very substantial increase. In view of the short range over which to accelerate, the time required for terminal handling and other factors, it is quite doubtful if a doubling of the velocity will have a significant effect on the total production of the average helicopter in our units. Our trucks are quite capable of running at 50 mph and occasionally do so, but in the combat zone they usually are restricted to the lower velocity mentioned.

It has sometimes been advanced that we need higher-velocity helicopters in order to reduce their vulnerability to enemy fire. Inasmuch as a true helicopter never can hope to reach the speeds of modern jet-propelled fighters, this looks like entering the same circular race which is resulting in fighters, whose size is beginning to impair their usefulness. In so far as ground fire is concerned, the helicopter's best protection seems to be in its maneuverability and ability to take advantage of natural cover like an infantryman rather than in its speed. It is not at all certain that a doubling of the velocity will halve the vulnerability of the helicopter to this source of danger. It must be expected that vehicles which frequently are used to move troops, equipment, and supplies in the forward battle areas will be hit by enemy fire, but we cannot afford unreasonable demands on our design in an effort to eliminate this possibility even if it were possible. As a matter of interest it has been observed that the present helicopters flying at 80 mph are quite difficult to detect from the ground because of their flight characteristics and slow relative movement. Although several have been hit by ground fire in Korea, the damage has not resulted in loss of the machines.

As already has been developed, the mission of the Army helicopter is a relatively short-haul one. Under such circumstances the total block time of the helicopter is not directly influenced by its flight speed. The ton-mile capability can more easily be increased by the use of quickly detachable slings for the cargo, facilities for rapid refueling, and other features which would decrease the ground time of the helicopter than by increasing its velocity. On a 30-mile trip an increase of flight speed from 100 to 200 mph gives a saving of only 9 min—a saving easily dissipated by less than maximum efficiency in ground handling. It also should be remembered that techniques such as flying in poor weather, operating over devious courses, and using natural defilade which normally will be employed to protect the helicopter and increase its surprise factor will usually require that it operate at considerably less than its maximum speed.

Hence it would appear that a maximum speed of 100 to 150 mph with the load and range developed in the foregoing should give us a helicopter of maximum utility without a premium for performance characteristics which will not be vital to the accomplishment of our mission. If a higher maximum velocity is obtained without additional expense as a result of other factors, it can of course prove useful but it cannot justify additional construction or operational expenses.

DESIGN FEATURES

In addition to the performance parameters which can be developed from our contemplated operations there are certain features of design which can be established by our objectives. It has been suggested that this end might be met by giving the engineer a military truck and asking him to design a rotor system to lift it. This should actually be quite close to our goal, since if the helicopter is to replace the truck there is no real reason for including in it features not found on the original vehicle.

Form. First, we should establish the general form of our new helicopter. Since we have decided that its maximum speed is relatively unimportant, streamlining and faring has become less of a prime object—of course, on the other hand, resistance of the fuselage directly affects the power requirements and fuel consumption and hence cannot be ignored completely. A rectangular box which has a larger internal capacity in relation to skin area or fuselage weight and offers one of the simplest manufacturing processes would appear to be the best fuselage form under these criteria. To decrease its resistance the front should be somewhat rounded, using as simple a shape as possible.

Since the principal fragile cargo of the helicopter will be personnel, it seems desirable that this box be enclosed or at least capable of being closed. On the other hand the skin of a conventional aircraft offers little or no protection against even rifle fire and hence there is no reason why this covering cannot be of cloth; certainly this is much less critical material in periods of rapid expansion of our military forces than is the standard aircraft aluminum used at present. Actually this covering could be removable exactly as the covering of the truck body is—so that it need not be carried when the weather and nature of the cargo do not require it. Frequently it has been observed that the Marines in riding their transport helicopters prefer to ride in the door with their feet hanging out—this feature would allow all passengers that pleasure if they like!

The cargo of our helicopter has been developed as vehicles and equipment, and normal items of supply in medium-sized packages. It has been well demonstrated that the latter is best carried in a cargo sling hung below the machine which can be detached readily and picked up without actually landing the helicopter. Under such assumption there is no necessity for incorporating any provision for stowing and lashing such loads within the body of the aircraft. Vehicles, too, have been carried by suspending them below the aircraft but in view of their relative delicacy and the fact that they would require some protection from the elements as well as the desire not to increase the drag too much, it seems desirable that the cargo body be capable of carrying its designated vehicle load inside and that the necessary ramps be included to load and unload rapidly. This does not appear to be a retreat from the thesis of making the box as light as possible, since a reasonable reserve of floor strength will be required as protection to the troops in autorotational landings.

With these thoughts in mind we have come up with a box-truss-type fuselage made of tubular or angle material with a

load-bearing floor, a rounded nose section, ramps to the ground, and side curtains for protection of the cargo or passengers in inclement weather. Under these conditions it should be possible to divorce this body entirely from the use of critical materials and production skills of the aircraft industry and to reduce its cost per pound to a figure on a par with the prices of automotive trailer or bus bodies. The artist's conception of an effective and economical military helicopter is shown in the frontispiece of this issue.

The equipment within this fuselage should be kept as nearly as possible commensurate with that found in bus and truck bodies and as many as possible of the elaborate special devices now installed should be eliminated. Lighting probably will be required but this should be restricted to one or two overhead fixtures which might well be portable dry-cell-powered flashlights. The present electrical intercommunication equipment could be replaced with a simple mechanical buzzer-rope as used in buses if an appropriate simple code were devised. It is questioned whether troops riding 15 to 20 miles in the combat zone require the elaborate troop seats now specified; it should be feasible to design a simple bench which could support the litters and serve as satisfactory seats as well. While some insulation is necessary, of course, it might be possible to accomplish this objective by making the side curtains of a glasswool-filled canvas quilt.

Rotor System. The design of the best rotor system for this helicopter is largely a technical problem for an expert in helicopter aerodynamics. Here, however, there are certain definite considerations which are dictated by our objectives. The rotor blades themselves should be as short and light as possible to facilitate their removal and adjustment in the field—this provision would seem to indicate the superiority of multiple rotors of three or four blades each even though this increases the number of transmissions required. Multiple rotors have a further advantage of increasing the allowable travel of the center of gravity which is a desirable feature for flexibility and ease of loading vehicles into the cargo body. The blades should be of metal to decrease the effect of rough usage and small-arms fire, but the present elaborate structure of pockets laboriously glued on spacers which are in turn glued on a delicately machined spar must be simplified drastically. Some way of forming a single sheet with the minimum of machine and hand operations undoubtedly can be devised. Already there is at least one such blade type in use and there appears to be no reason why serious effort in this field should not be remunerative. A simple balance and tracking device and procedure must be developed at the same time so that all blades can become truly interchangeable and readily adjustable under field conditions.

Power Plant. A great deal has appeared in the technical press of late about the relative merits of the various power-plant systems for helicopters. The strange aspect of most of these discussions is the facility with which each author has been able to demonstrate the marked advantage of the power system advocated by his company. Perhaps the principal thing to be gained in this discussion is that actually there is not as much difference between the various types of rotor-drive systems as might appear at first glance.

All of the helicopters flying today with the exception of a few individual experimental types are powered by standard aircraft piston engines driving their rotors through a series of reduction-gear systems. However, the requirement for approximately 20 per cent more power than the equivalent lift fixed-wing aircraft is leading to the use of the very latest, very high-powered engines which are extremely complicated and expensive and require the best premium aircraft fuel. Additionally, the requirement for maintaining a fairly constant rotor rpm leads to inefficient use of the engine and an increase in its maintenance. On the other hand these engines have been developed carefully over a long period of time for aircraft applications with emphasis on a low pounds per horsepower factor and a low specific fuel consumption. Since these engines are not designed for this application they require the use of reduction gears which add weight and cost to the machine and increase its maintenance requirements. On the other hand these engines, being specifically developed for aeronautical usage, have a long-established life in aircraft operation which simplifies their maintenance. Perhaps the most important factor in considering this drive system, however, is its direct relationship with the aircraft industry. A helicopter of the size developed here probably would use two of the standard transport-type engines and these would not be readily available in the mobilization period. Therefore it would appear desirable to avoid the use of standard aircraft engines with reduction gears if possible.

The next adaptation which has been tried in an experimental basis has been to substitute a gas turbine for the standard aircraft engine. The advantage gained is primarily in the lower weight of the engine itself with some increase in the weight of the reduction gears because of the higher speed of the engine and considerable increase in fuel consumption. This latter fact is somewhat offset by the fact that the gas turbine can be designed to use a lower grade and wider range of fuel than the standard aircraft engine and hence its fuel costs in dollars and cents at least might be no higher. If the gas turbine used is of the relatively heavy-duty type developed for commercial application there should be no conflict here directly with the aircraft industry except in the special materials required for the turbine vanes. Commercial engine designs are usually more rugged than those of the aircraft field and here they should show good useful life characteristics. An additional advantage to this drive system for the military helicopter is that it is the least noisy of all systems—usually the blades make more noise than does the engine.

Pressure-jet application to helicopter rotor-drive systems involves the piping of compressed gases to the rotor tips and ejecting them with or without the addition of afterburning. This is actually one of the oldest proposed systems for rotor drive and has much to recommend it. Essentially it eliminates torque in the rotor and eliminates the requirement for anti-torque devices in single-rotor ships; since we have already decided on multiple rotors this presents no real value here. It removes the requirement for a heavy, expensive, and sometimes troublesome reduction gear although the ducting requirements are not entirely simple in themselves. The weight of such a system probably will approach that of the turbine-gear drive although it may be somewhat less—its operating cost in fuel consumed will be somewhat higher. One additional advantage of the pressure-jet system is that the afterburner feature may be used during periods of maximum horsepower requirement as in take off, hovering, landing and then only the more efficient pressure system employed for cruising. Of course, during the use of the afterburners the fuel consumption will be quite high and hence it is not felt to be entirely practicable to consider cruising with this power. A further complication in the pressure-jet system will be the requirement for special alloys in the ducts to resist the high gas temperatures which again will increase the cost of this type.

Of the tip-mounted plants only the ram and pulse-jet types are even reasonably feasible at the present time and both of these have been installed in small, experimental craft. They have the advantage of mechanical simplicity, low cost, and

ease of maintenance, usually by exchanging engines, but they pay for these advantages with a quite high fuel cost—it has been stated that the fuel requirement of one of the two-place ram-jet models was roughly equal to that of a DC-3. In this power system the engine weight reaches the minimum and therefore the air-frame deadweight is at its lowest. On the other hand the body must be built to carry many times more fuel than other types and contain provisions for its protection. As a military vehicle these engines have the disadvantage of being very noisy and possibly would be visible at night.

From a consideration of all these factors it seems we should choose as to the best power system for our ideal helicopter a standard, commercial-type, gas turbine reduction gear combination. A concerted effort in the field should result in a light-weight long-lived propulsion system with a reasonable fuel consumption. In view of the light engine weight, the gas-turbine system will allow us to use multiengines with little weight penalty for the added safety factor.

Equipment. There is room for considerable savings in weight, cost, and production skill in all helicopters in the equipment, in the operator's compartment. As each new radio, navigation, or operating device has been developed in the aircraft field we have added it to the already imposing array. This in turn has required larger generators, stand-by equipment, and other accessories until the accumulation already has passed the reasonable limit. While it is admitted that the pilot should be given reasonable consideration in the equipment and reasonable precautions must be taken to avoid an equipment failure, the criteria for selection of this equipment again should not be appreciably more elaborate than for the truck, except for items clearly required for essential flight safety.

The radio equipment therefore should be limited to that required to contact the operations base and the ground unit with which the helicopter is working. Radio channels in the forward areas are already oversaturated and, if we are trying to be of service to forward areas, we shouldn't insist on using up a critical commodity to do it. In so far as navigational equipment is concerned it should only be that required for V F R operation in the forward areas with normal Army maps. In view of the negligible proportion of the time when a helicopter, flying slow and low, cannot complete its mission over the short distances involved in contemplated Army objectives, we are fully justified in taking a calculated risk in omitting blind-flying instrumentation—this would save not only the expense of this equipment and of the ground equipment to support it, but also the not inconsiderable cost of training the transport helicopter pilot to use it. As a specific precaution for the unusual situation, perhaps, a proportion as high as one fourth of our utility helicopters and their pilots could be capable of operation under instrument conditions since these aircraft will be more often required in vital evacuation or supply missions to use very small units which might not be able to subsist for an extra hour or two without support.

Autopilots and other refinements to the operating equipment of the helicopter under consideration do not appear necessary. While it is admitted that the pilot-fatigue factor in a helicopter is quite high, it also must be recognized that flights being considered here are of relatively short duration and that if the helicopter is to fly a devious course to protect itself, the autopilot will not be too much assistance. It is recognized, on the other hand, that the controls will have to have hydraulic or other boost devices on a machine of the size we have developed in order for it to be handled effectively.

The use of the cargo-sling technique will require that the helicopter be equipped with sling-suspension devices but, on the other hand, the rescue winch and hatch now installed on all helicopters regardless of mission should be dispensed with on all Army helicopters except for the utility type. These sling devices should be static or manually operated in so far as possible to eliminate the requirement for additional power.

The foregoing are some of the specific areas in which an improvement may be made in our present helicopters by elimination or simplification of equipment and accessories. Each of these devices which can be eliminated decreases the empty weight and the structural requirement of the basic machine. Most of these accessories also are subject to wear and require maintenance and parts for their support. Each item which can be eliminated thus starts a chain reaction of savings whose beneficial effects reach the battle area.

CONCLUSION

Special-purpose military vehicles must be designed with their mission clearly in mind. Quite frequently this will require an abandonment of the rules of the design which have been established for similar commercial equipment. The dictates of economy likewise will recommend a change from standard engineering practice in military problems; our normal military-construction practice uses far lower safety factors than those of the most liberal building code. The present practice of designing Army helicopters in strict compliance with all of the construction rules of the "Handbook for Aircraft Designers" and the CAB is resulting in excellent helicopters for luxury passenger service and similar usage, but is all but prohibiting the procurement of a machine for Army use.

By the use of objectives and features such as those briefly mentioned and a vigorous campaign toward these goals, it should be perfectly feasible to develop an easily producible 6000-lb-pay-load helicopter whose mass-production price will be less than $100,000—present trends indicate that unless some such drastic measures are taken, those now being designed will cost at least five times that figure. The objective should be to produce a helicopter whose price and operating costs on a ton-mile per hour basis are no greater than those of a standard military truck.

BRITISH designers are well ahead with plans for helicopters which combine many of the advantages of the large rotating-wing machine (which takes off and lands vertically without runways) with those of the fixed-wing airplane with a faster forward speed.

Development work is going ahead on a contract, placed by the Ministry of Supply, for a form of rotary-wing machine which is also driven along by conventional propellers. This will be based on the Rotodyne design developed by the Fairey Company.

The first flight of a machine combining the two principles will probably be from Bristol—a version of the twin-rotor Type 173 passenger helicopter, with stub wings, a retractable undercarriage, and more powerful engines. British European Airways hope to operate this modified helicopter on some inter-city routes in Britain after the completion of tests.

It is thought likely that designs produced to B.E.A.'s large 40-seat helicopter specification will also incorporate fixed wings. One possible design has already been mentioned, the Type 181, a larger, faster, scaled-up version of the 173. Other designs will probably feature gas-turbine engines.

Development of the Fairey Rotodyne principle is toward a 23-passenger "feeder-line" type of aircraft, driven forward by two turboprop engines mounted on short, shoulder-high wings, but with jet-propelled rotor blades mounted above the cabin. Air will be tapped from the two conventional turboprop engines, out along the blade tips, where separate reaction motors are mounted to give extra power for take-off and landing. Development work on these power units is now under way.

CHOOSING NEW MACHINERY *and* EQUIPMENT

Economic and Philosophical Considerations

By D. M. PATTISON

VICE-PRESIDENT—SALES, THE WARNER & SWASEY COMPANY, CLEVELAND, OHIO

THE demands being made on the capital-goods industries, and their customers, as a result of our defense program, have pushed the whole subject of dynamic equipment policies definitely into the background.

Since July 1, 1950, it has been a question of how soon and how much, regardless of cost. Many pieces of equipment have been continued in service—not scrapped; many operations are being performed on machines of improper size or type; old methods or processes have been continued because of the inability to obtain new proper equipment. And so it goes—defense, like war, is wasteful.

It would seem that this is a most appropriate time to restate and re-examine the economics and philosophy of choosing new machinery and equipment; to focus our thinking and forward-planning so as to be fully prepared by the end of the defense effort; to re-establish our perspective on efficient operations; and to reactivate equipment policies.

It should be made clear at the outset that the author does not claim to be an expert on replacement policy. We will leave for the real experts the mathematical and algebraic calculations presupposed by a replacement formula. Rather, the practical application of a proper replacement program, and some of the basic underlying principles will be discussed, and reference will be made to sources of additional information which will provide a more detailed and comprehensive background.

WHEN TO BUY NEW CAPITAL EQUIPMENT

The decision to buy new capital equipment is a long-range commitment involving the future for many years ahead. In order to time our purchases properly, we need a knowledge of future developments which, of course, is not generally available. Thus we must make reasonable estimates and assumptions regarding the future.

The importance to management in having a proper replacement policy can be emphasized in numerous ways. For example, one company 50 years old with total assets of $73,000,000 shows a total of $34,000,000 in its plant and equipment account. Reserves of $14,000,000 have been set up against this, leaving a net of $20,000,000, which equals 27½ per cent of the total assets—a sizable part of total assets. Depreciation set aside during 1950, amounted to $1,690,000, or roughly 8 per cent of its net plant and equipment account. How well and intelligently this sum is reinvested by the management is bound to have an enormous influence on the future earnings of this company.

Postponing the reinvestment of these funds could be a serious mistake. Since June, 1950, owing to inflation, this company would need today an additional $253,000 to purchase the same amount of equipment. A proper replacement program would have indicated, ahead of time, how these funds could have been reinvested profitably.

A GOOD EQUIPMENT POLICY

The chances are that the reader, like most industrial executives, believes his company has a good equipment policy. Perhaps it has, but is he sure? Suppose this conviction be tested by three simple questions:

1 Do you know what equipment in your plant is at present economically replaceable, and on what assumptions as to the future it is so?

2 Do you know what it is costing the company, on the basis of these assumptions, not to make the indicated replacements?

3 Do you have an organization setup that keeps you currently and continuously informed of available replacement opportunities?

If these questions can be answered affirmatively, the company has at least the basis for a good equipment policy, whether it achieves one or not. But if an affirmative answer cannot be given, even the basis is lacking.

Time and timing are our main problems. A hardheaded, accurate, and intelligent replacement policy tells when to replace and with what choice of equipment. Likewise, it will tell when not to replace, which many times is more significant. Obviously, all equipment must be replaced at some time, and our investigations must give us the answer to "When does it pay us to replace a present machine with a new proper machine?" as well as the answers to why it is profitable.

Age or length of service is not the only yardstick to be used. Obsolescence takes a larger toll and, like some of our insidious diseases, can run along for years, causing loss of profits and a weakened competitive position only because management does not know periodically what it is costing "not to replace."

While physical deterioration is still an important factor, external change—obsolescence—must be given even greater weight. In our modern world, with rapid advances in scientific and technical progress, capital goods must be checked continually for replacement for other causes than physical decay. In the author's opinion, it is a lack of understanding of this latter phase of our problem that causes many companies to adhere to replacement policies that are antiquated and costly. One of our common hurdles is the short pay-off period. This position taken by management is based on an erroneous assumption that a piece of equipment should be paid for in one, two, or three years to be a profitable investment.

While such a return is unquestionably profitable, this theory of "short-term pay-off" cannot help but ignore the very real profit-producing potential in capital goods which doesn't quite satisfy the arbitrary pay-off period.

For example, if a capital investment of $10,000 must be re-

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covered or paid off in two years, an annual savings of $5000 must be realized.

Suppose that this investment cannot return $5000 per year but only an average of $2000 per year for a period of six years, at which time the difference between the present and proposed equipment finally proves out at the rate of $5000 per year.

On that basis the present equipment obviously has been overprotected for a period of six years and $12,000 of very real profits have been lost by adherence to a synthetic replacement signal.

Another and just as important factor is the refusal to calculate and include all operating costs involved, and insistence on the use of direct labor savings only.

If management would review yearly all its plant equipment, a sound, progressive, and profitable replacement policy inevitably would result. Rule-of-thumb tests certainly have no place in our economy today.

WHAT IT COSTS NOT TO REPLACE

From a practical standpoint we should analyze how we would go about obtaining the information so as to show management what it is costing not to replace. There is no quick and easy method of replacement analysis, and certainly this part of a program needs proper administration. Re-equipment involves large capital outlays. Cost and revenue considerations vary from one situation to another, and potential results are dependent to a large degree upon correct decisions, careful study, and thorough understanding by top management.

To begin with, a capable person must be appointed to direct the work. He may be just one individual assigned to the plant-engineer's office, or he may be made head of a new department employing several individuals. He must be, or develop into, an equipment specialist.

The first assignment is to work up a set of standard procedures, an analysis sheet, and a set of instructions. Many companies have developed their own manuals covering all of these factors.

Top management periodically must review all reports brought to it by the replacement-analysis group. It should be emphasized that management must review *all* reports, as experience has proved that in many organizations only those situations which are long overdue for replacement are ever brought to management's attention. This is management's own fault, as the men who are responsible for detailing these reports have learned that unless a suggestion is open and shut, management generally turns a deaf ear.

A proper manual should provide a uniform system of evaluating present shop methods and equipment in relation to shop methods and equipment that might be installed. With this system it is also possible to make a choice between two or more new methods or items of equipment that might be installed for the same purposes. The principle involved is this: The present method or equipment is charged with the cost of operation plus the capital cost of staying in operation for the next year; this value is then compared with the service-life average of operating costs and capital costs of the proposed method or equipment. These costs for the proposed method or equipment cover deterioration, obsolescence, and recovery of investment with interest. From this comparison a clear idea can be gained of the next year's profit or loss resulting from replacement.

To simplify this procedure, our own company is using the

Analysis: OPERATING COSTS	Present Equipment (differences only)	Proposed Equipment
Direct Labor 1,000 hrs. x 1.95	$1,950.00	
Maintenance 40 hrs. x 2.00 = 80.00 repair parts 75.00	155.00	
Down Time		
Adaptability of Machine to Range of Work		
Scrap and/or Salvage	200.00	
Floor Space		
Cutting Tools	50.00	
Value of Increased Output		
Power, Insurance & Property Taxes		125.00
Indirect Labor		
Supervisory and Administrative		
Supplies		
Other		
Totals	$2,355.00	$ 125.00

Present Equipment

1. COST OF DEFERRED DISPOSAL:
   - Salvage Value Now $2,200.00
   - Salvage Value Next Year . . . $2,000.00
   - Net Loss $200.00
   - Plus 10 % Interest On Salvage Value Now $220.00
   - Total $420.00

2. MAJOR REPAIRS OR ADDITIONS: None
   - Outlay $_____. Outlay Prorated for Next Year's Service Based On _____ Years Profitable Life $_____
   - Interest On Outlay $_____
   - Total $ X X X

3. NET DIFFERENCE (operating costs) $2,230.00

4. NEXT YEAR'S EXCESS COST OF OPERATION (Sum of Totals 1, 2 and 3) $2,650.00

5. TOTAL ANNUAL OPERATING COSTS OF PROPOSED EQUIPMENT AVERAGED OVER ITS SERVICE LIFE (See M.A.P.I. Chart Factors) $2,470.00

M.A.P.I. Chart Factors
- a) Service Life 12 Years
- b) Terminal Salvage Value $ 2,600.00
- c) Total Investment $13,000.00
- d) Ratio of Salvage Value to Total Inv. 20 %
- e) M.A.P.I. Factor 9 %
- f) Required Return on Investment 10 %
- g) see above--(e + f) x c = $ 2,470.00 (enter this result as Item 5)

Next Year's Excess Cost of Not Replacing Present Equipment . . . . . $ 180.00
(After Full Allowance for deterioration, obsolescence and recovery of the investment with interest in the proposed equipment)

Description:
PRESENT EQUIPMENT #3-40H Turret Lathe (1935 Model)
PROPOSED EQUIPMENT #3 Electrocycle Turret Lathe (New)
Date: 2-29-52

Copyright 1952 Warner & Swasey Co., Cleveland 3, Ohio

FIG. 1 COMPARISON OF TOTAL ANNUAL COSTS OF OPERATION BASED ON MAPI EQUIPMENT-REPLACEMENT FORMULA

MAPI formula[1] which makes certain assumptions and approximations, but as long as these are applied in the formula with proper discrimination to both sides of the comparison, the resulting analysis will be correct.

We have worked out our own manual which consists of a work sheet, a section explaining the use of this form, and detailed instructions covering each item that appears thereon. Further, we have itemized all direct labor rates for each department and have included in these direct wages an amount for the following fringe benefits: Paid vacations, employees' federal old-age benefits, state employment insurance, night-rate premium, pension fund, and loss on cafeteria, as these items are just as much a part of our direct labor cost as the actual money that we pay out.

The equipment analyst must be provided with the current electric rate. He must know the charge per square foot of floor space per year. He must have a formula or other means of computing the personal-property taxes on equipment and any other factors that should be taken into consideration in making his detailed report.

APPLICATION OF THE MAPI FORMULA[1]

Three typical examples will illustrate the application of the Machinery and Allied Products Institute formula.

Fig. 1 compares the total costs of operation for a year ahead of a 17-year-old turret lathe in need of only minor repairs with a greatly improved model of similar capacity. Items 1, 2, and 3 deal with the costs of operation of the old machine.

1 *Cost of Deferred Disposal.* This indicates that a loss of $200 would occur if the machine were not sold now, but rather one year hence; these figures being based on a "normal" market in used machinery.

In addition, a loss of 10 per cent in interest on the present salvage value (10 per cent of $2200 = $220) must be considered. This makes a total of $200 plus $220, or $420, which is the cost of delaying the disposal of the old machine for one year.

2 *Major Repairs or Additions.* Since the old machine needs only minor repairs or maintenance, no capital expenditures are required to keep it in operation for the next year.

3 *Net Difference in Actual Operating Costs.* The all-inclusive table in the upper left-hand corner of Fig. 1 lists the possible bases on which actual operating costs can be compared between the two machines. The dollars actually entered in the columns are the "excess" costs of the one over the other.

For example: the new machine will save 1000 hr of direct labor over the old machine. Thus 1000 hr times the rate of $1.95 per hour (including fringe benefits), which equals $1950, is charged *against* the present or old equipment. In similar manner, the savings for maintenance, scrap, and cutting tools are in favor of the new machine and are thus charged against the old.

The net difference in these two columns, $2230, is entered as item 3.

4 *Total Cost of Operating Old Machine.* This is the sum of items 1, 2, and 3 and is the total cost of operating the old machine for one year hence.

5 *Total Annual Operating Costs of Proposed Equipment Averaged Over its Service Life.* In order to compare the total costs of operating the old and new machines for one year ahead, these charges for the new machine must be predicted, and this is done through the use of the MAPI formula. For convenience, the formula is used in the form of a chart, Fig. 2; refer also to the list of MAPI chart factors in the lower left-hand corner of the work sheet, Fig. 1.

[1] "Dynamic Equipment Policy," by George Terborgh, Machinery and Allied Products Institute, McGraw-Hill Book Company, Inc., New York, N. Y., 1949.

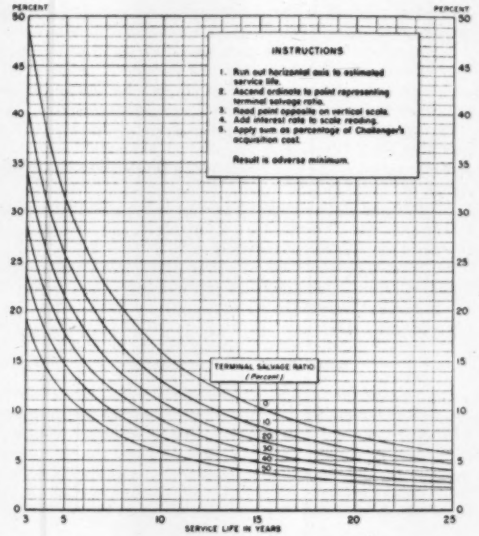
PERCENT
PERCENT
INSTRUCTIONS
1. Run out horizontal axis to estimated service life.
2. Ascend ordinate to point representing terminal salvage ratio.
3. Read point opposite on vertical scale.
4. Add interest rate to scale reading.
5. Apply sum as percentage of Challenger's acquisition cost.
Result is adverse minimum.
TERMINAL SALVAGE RATIO (Percent)
SERVICE LIFE IN YEARS

FIG. 2 CHART FOR DERIVING CHALLENGER'S ADVERSE MINIMUM BY THE MAPI FORMULA

(*a*) *Service life:* This is estimated from experience to be 12 years. Note that service life is not physical life but the age at which potential replacement again might be indicated.

(*b*) *Terminal salvage value:* This is the estimated disposal worth of the new machine based on a normal market at the end of the service life.

(*c*) *Total investment:* The present cost of the new machine usually includes the cost of electrical equipment, tooling, and installation.

(*d*) *Ratio of salvage value to total investment, per cent:* In this example, $2600 is 20 per cent of $13,000.

(*e*) *MAPI factor:* The value of 9 per cent is read from the chart in Fig. 2, using the service life of 12 years and per cent figure (20 per cent) in item (*d*), Fig. 1.

(*f*) *Required return on investment:* Each company must determine its own value for this figure. It must be realistic, however, and reflect the true responsibility implied in expending company funds. For this example, this return is figured at 10 per cent.

(*g*) *Items (e) and (f) times item (c):* The MAPI chart factor of 9 per cent is added to the 10 per cent required return and multiplied against the total investment. The result, 19 per cent of $13,000, is $2470 and is entered at item 5.

Conclusions. If item 5 is equal to or less than item 4, then the signal is evident for replacement.

Note that whether item 5 is equal to or less than item 4, replacement is indicated because the costs of operation of the new machine already have made full allowance for deterioration, obsolescence, and recovery of the investment with interest.

If the replacement is not made when the costs in items 4 and 5 are equal, this in effect ignores a potential or imminent source of excess cost of operation plus loss of the 10 per cent return on the investment.

If the replacement is not made when item 4 is larger than item 5, this in effect stamps company acceptance not only of a loss in revenue but also of actual excess dollars spent in keeping the old machine in service.

Analysis: OPERATING COSTS	Present Equipment (differences only)	Proposed Equipment
Direct Labor 2,000 hrs. x 2.01 (includes fringe benefits)	$4,020.00	
Maintenance Lub. time and material plus misc. adjust.	150.00	
Down Time		
Adaptability of Machine to Range of Work		
Scrap and/or Salvage	200.00	
Floor Space		
Cutting Tools 75/yr Including re-sharpening at 6.00/cutter	450.00	
Value of Increased Output		
Power, Insurance & Property Taxes		150.00
Indirect Labor 1 hr./day at 1.50 (200 days)	300.00	
Supervisory and Administrative		
Supplies belts - coolant, etc.	40.00	
Other		
Totals	$5,160.00	$ 150.00

Present Equipment

1. COST OF DEFERRED DISPOSAL:

Salvage Value Now. $4,800.00

Salvage Value Next Year . . . $4,320.00

Net Loss $480.00

Plus 10 % Interest On Salvage Value Now. $480.00

Total $960.00

2. MAJOR REPAIRS OR ADDITIONS: (Two Machines)

Outlay $15,750.00 Outlay

Prorated for Next Year's Service Based On 5 Years Profitable Life $3,150.00

Interest On Outlay 10% x $15,750.00 $1,575.00

Total $4,725.00

3. NET DIFFERENCE (operating costs) $5,010.00

4. NEXT YEAR'S EXCESS COST OF OPERATION (Sum of Totals 1, 2 and 3). $10,695.00

5. TOTAL ANNUAL OPERATING COSTS OF PROPOSED EQUIPMENT AVERAGED OVER ITS SERVICE LIFE (See M.A.P.I. Chart Factors) $6,849.00

M.A.P.I. Chart Factors

a) Service Life 10 Years

b) Terminal Salvage Value $5,500.00

c) Total Investment $31,857.00 (Including Tools)

d) Ratio of Salvage Value to Total Inv. 17 %

e) M.A.P.I. Factor 11.5 %

f) Required Return on Investment 10 %

g) see above--(e + f) x c = $6,849.00

(enter this result as item 5)

Next Year's Excess Cost of Not Replacing Present Equipment. $3,846.00
(After Full Allowance for deterioration, obsolescence and recovery of the investment with interest in the proposed equipment)

Description:

PRESENT EQUIPMENT Two 4A Turret Lathes (1935 Model)

PROPOSED EQUIPMENT One 4A Turret Lathe (New and Improved Model)

Date: 2-29-52

Copyright 1952 Barnes & Bonney Co. Cleveland 3, Ohio

FIG. 3 COMPARISON OF TOTAL ANNUAL COSTS OF OPERATION BASED ON MAPI EQUIPMENT-REPLACEMENT FORMULA

For the example in Fig. 1, according to the foregoing analysis, the excess cost for the next year ahead of not making the replacement after full allowances is $180.

The sheet in Fig. 3 compares costs of operation for one year ahead where one new and improved machine is proposed to replace two 17-year-old machines in need of major overhaul.

1 Analysis same as for Fig. 1.

2 *Major Repairs or Additions*. It is estimated that $15,750 is needed to rebuild the two old machines before they can give adequate service for the next year's operation. This charge is prorated on the basis of a 5-year profitable life, or $3150 for the next year. Interest on the total outlay (10 per cent × $15,750) is added to prorated rebuild charge ($1575 plus $3150), and this total ($4725) is entered as item 2.

3 *Operating Costs of Present Equipment*. Since one new machine in this example is known to produce the same volume as the two old machines, one man-year (2000 hr) is saved in direct labor.

The complete analysis of item 3 indicates a net difference in operating costs of $5010.

4 The sum of items 1, 2, and 3 is $10,695.

5 Based on the MAPI formula, the total annual operating cost of the new machine, averaged over its service life, is $6849.

Conclusions. The difference in items 4 and 5 is $3846. This is the excess cost for the next year ahead of not making the replacement after allowance for deterioration, obsolescence, and recovery of the investment with interest.

Fig. 4 describes a multiple-unit machine-replacement analysis wherein 13 new turret lathes are proposed to replace 20 old turret lathes.

1 *Cost of Deferred Disposal*. In this case, a normal market value of $1000 is assigned to each of the 20 old machines. The drop in value over the next year is estimated at $100 per machine resulting in a net loss of $2000. This loss plus the interest on the present salvage value (10 per cent × $20,000) equals $4000, or the cost of deferred disposal for one year.

2 It is estimated that the 20 old machines would not need any major rebuilding to keep them in service for one year hence.

3 Under operating costs, it is known that 7 man-years (7 × 2000 hr) are saved in direct labor when replacing 20 old machines with 13 new machines. Thus 14,000 hr at $2 per hr, or $28,000, is charged as an operating cost to the old machines. The remaining factors in item 3 likewise are handled as previously described. The net difference between the old and new machines ($40,270) is listed in item 3.

4 This item is the sum of items 1, 2, and 3. It totals $44,270, which is the next year's excess cost of operation for the battery of 20 old machines.

5 In this example the battery of 13 new machines will average over its service life a total annual operating cost of $35,152. This cost is figured by the MAPI chart, using factors listed in the lower left-hand corner of Fig. 4.

Conclusions. For a period of the next year, this analysis indicates an excess cost of $9118, which will accrue should this replacement not be made—even after charging the proposed equipment with allowance for deterioration, obsolescence, and recovery of the investment with interest.

While these three examples are just random samples illustrating the practical application of the MAPI formula to three specific problems, many others of equal interest could be cited. For instance, in analyzing a textile-mill problem, we found that a certain machine which we manufacture would pay for itself just on the saving of waste alone. In another case, in our own

Analysis: OPERATING COSTS	Present Equipment (differences only)	Proposed Equipment
Direct Labor 7 men x 2,000 hrs. x 2.00 1 hr.	$28,000.00	
Maintenance 20 machines x 153.00	3,060.00	
Down Time		
Adaptability of Machine to Range of Work		
Scrap and/or Salvage 240.00 x 13 machines	3,120.00	
Floor Space	140.00	
Cutting Tools 350 cutters plus re-grinding at 3.00 per cutter	1,050.00	
Value of Increased Output		
Power, Insurance & Property Taxes		1,300.00
Indirect Labor (Setup Man and Misc.)	6,000.00	
Supervisory and Administrative		
Supplies (Coolant-belts-lubricant etc.)	200.00	
Other		
Totals	$41,570.00	$1,300.00

*Thirteen new machines will produce $240.00 less scrap per machine than defending setup of 20 machines

Present Equipment

1. COST OF DEFERRED DISPOSAL:
   - Salvage Value Now . . . . . $ 20,000.00 (20 x $1,000.00)
   - Salvage Value Next Year . . . $ 18,000.00
   - Net Loss $ 2,000.00
   - Plus 10 % Interest On Salvage Value Now . . . . . $ 2,000.00
   - Total $ 4,000.00
2. MAJOR REPAIRS OR ADDITIONS: None
   - Outlay $ _____ Outlay
   - Prorated for Next Year's Service Based
   - On _____ Years Profitable Life $ _____
   - Interest On Outlay $ _____
   - Total $ X X X
3. NET DIFFERENCE (operating costs) $ 40,270.00
4. NEXT YEAR'S EXCESS COST OF OPERATION (Sum of Totals 1, 2 and 3) . . . . . $ 44,270.00
5. TOTAL ANNUAL OPERATING COSTS OF PROPOSED EQUIPMENT AVERAGED OVER ITS SERVICE LIFE (See M.A.P.I. Chart Factors) . . . . . $ 35,152.00

M.A.P.I. Chart Factors

a) Service Life 12 Years
b) Terminal Salvage Value $ 16,900.00 (13 machines)
c) Total Investment $ 169,000.00
d) Ratio of Salvage Value to Total Inv. 10 %
e) M.A.P.I. Factor 10.8 %
f) Required Return on Investment 10 %
g) see above--(e + f) x c = $ 35,152.00
(enter this result as item 5)

Next Year's Excess Cost of Not Replacing Present Equipment . . . . . $ 9,118.00
(After Full Allowance for deterioration, obsolescence and recovery of the investment with interest in the proposed equipment)

Description:

PRESENT EQUIPMENT 20 Old Turret Lathes

PROPOSED EQUIPMENT 13 New Turret Lathes

Date: 2-29-52

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FIG. 4 COMPARISON OF TOTAL ANNUAL COSTS OF OPERATION BASED ON MAPI EQUIPMENT-REPLACEMENT FORMULA

plant, we were able to justify the purchase of a $25,000 milling machine as a result of savings made entirely outside of the milling machine department. This was true because the work could be held to more accurate limits, thereby reducing set-up time and machining time in subsequent operations, and because better tooling and fixtures could be employed.

We have also had cases where absolutely no direct labor saving was involved at all, and still a sizable return was indicated by the type of analysis we have been discussing. As an example, one firm replaced fourteen automatic machines with six new machines, but employed the same number of operators and set-up men. In other words, the total labor cost per year for that department was exactly the same as when the fourteen machines were in operation. Saving of floor space, down time, maintenance, scrap, cutting tools, and supervisory and administrative expenses more than justified this replacement.

A DYNAMIC EQUIPMENT POLICY

By now many readers may have come to the conclusion that because of the author's position with one of the machine-tool companies, he is entirely prejudiced concerning this whole subject. In spite of any such prejudice, it can be proved that a dynamic equipment policy must be based on a co-operative effort on the part of the purchaser and seller.

For instance, as may be realized from the three typical examples discussed, the purchaser must contribute the following information to make our analysis work: Hourly rates, including fringe benefits; floor-space cost; present production rates; maintenance cost; cost of capital; down time; scrap or salvage loss; cutting tools; power, insurance, and property-tax costs; indirect labor cost; supervisory and administrative costs; and any others that might become involved.

The manufacturer or seller must furnish the purchaser or user with the following key information: Production that can be obtained from the new equipment; service life of the new equipment; probable terminal salvage value of the new equipment; cost of major repair or rebuilding present equipment; and the possible salvage value of equipment under consideration as well as its future salvage value a year hence.

Salesmen in the capital-goods industries must not look upon a replacement program simply as a tool for getting new business. They must be just as ready to point out to a prospective customer those machines which should not be replaced as those where replacement is indicated. The whole program must be one of mutual benefit. Since the collective sales forces of the various capital-goods industries will have a very strong influence on this program, any misunderstanding or shortsighted policy on their part can work a great deal of harm. Furthermore, we all should recognize the fact that the program we are talking about, not just for the individual plant but for United States industry in general, is not one to be accomplished over a few months or a year. It must be a continuing program, and each year should see it more widely accepted.

For help in organizing and putting into operation a dynamic equipment program, the following study is recommended:

In 1949 the Machinery and Allied Products Institute published "Dynamic Equipment Policy,"[1] written by Mr. George Terborgh, Research Director of the MAPI staff. This book is probably the most thorough and detailed study of the replacement problem. Mr. Terborgh developed the MAPI formula, which is being used by many companies. Later the Machinery and Allied Products Institute sponsored the MAPI "Replacement Manual," which boils down into a few pages the essential

(Continued on page 741)

THE ITALIAN POWER INDUSTRY

By PIERO FERRERIO

CHAIRMAN AND PRESIDENT, ITALIAN EDISON COMPANY, MILAN, ITALY

I SHALL begin with a brief historical review of the most important events in the development of the Italian power industry from its origin in 1883, when the Santa Radegonda Power Station went into operation in Milano. That station was equipped with four original "jumbo" dynamos bought in the United States and was chronologically the first public-utility power plant in Europe. John W. Lieb, close associate of Thomas Alva Edison, was sent by him to take charge of the construction and then of the operation of the plant.

HISTORICAL SUMMARY

Up to the beginning of the first World War, during what we might call the "pioneers" period, the Italian power industry laid the foundations for its later development as a great modern industry.

During the years between the first World War and the eve of the second World War, our industry went through a stage of fast development and took on a typically hydroelectric character. Consequently, the dominating problem of that stage was the necessity of adapting the diagram of available water power to the diagram of demand. This means making output independent, in so far as possible, of the wide variations of water flow characteristic of our rivers, without, however, limiting the installed capacities to minimum flow level. Such result was obtained within its economic limits, in a country very poor in fuel, by building large reservoirs high up in the mountains.

Between the end of the first World War and 1936, the average yearly rate of increase of hydroelectric output capacity was 9.5 per cent.

After 1936 conditions became increasingly unfavorable to the installation of new power plants: The government's economic policy brought about an increasingly strict control of private enterprise. After 1939, and through the war, new construction came abruptly to a stop, mainly on account of the lack of raw materials, labor, and capital.

The industry nevertheless was able to satisfy wartime power requirements, thanks to the margin between availability and demand that had always been previously maintained.

The dwindling construction activity was accompanied by the destruction, through events of war, of many installations (a total of 1,200,000 kw hydroelectric, and 437,000 kw thermoelectric) and by the peace-treaty-imposed loss to adjoining countries (France and Yugoslavia) of a total capacity of 120,000 kw.

This is why the power industry at the end of the war could count on an effective capacity just equal to that of 1938, and much lower than the peak reached in 1941. On the other hand, the existence of a potential and unsatisfied demand brought the requirements for power up to a level much higher than that available.

Faced by such a situation, and despite the most serious economic and financial difficulties, the Italian power industry actively proceeded with its work—begun while the war was still going on—of reconstructing those installations which had been damaged or destroyed. New projects were started, and during 1948 a co-ordinated program of new installations was completed and approved by the proper government agencies.

That program, which is now nearly completed, includes stations that will be capable of generating approximately 11 billion kwhr a year. The financing of the hydroelectric and geothermic installations is borne directly by the companies. Also steam power units for an aggregate capacity of 800,000 kw are being installed, and some of them are already in operation. Most of the turbine-generators and boilers are large-capacity U. S. manufactured equipment bought through ERP dollar loans.

All this work has required, and still requires, a financial effort of about 150 billion lire per year, the equivalent of approximately $250 million. This amount may not sound very impressive to persons thinking in terms of American activity in this field. However, facts and figures must be evaluated considering the whole picture of the economic situation in which they develop. It will be enough to remember that the U. S. national income is 18 times higher than the Italian national income.

The effort involved in the expansion of our industry in Italy has been proportionally greater than that of other European countries notoriously richer. In fact, the yearly average percentage increases in capacity between Dec. 31, 1946, and the end of 1951, were 8.51 per cent in Italy, 6.4 per cent in France and 6.95 per cent in England. But the financial effort for Italy is still larger when total expenditure rather than capacity is considered. This is due to the fact that England is practically 100 per cent a steam-power country and France approximately 50 per cent steam and 50 per cent hydroelectric. The investment required in Europe today for the installation of hydroelectric capacity is 2 to 2.5 times that for a corresponding steam-power capacity. Therefore, the financial expenditure of the Italian power industry can well be considered much greater than that of other countries with far larger financial resources.

As a result of these efforts, we obtained a continued increase of our output: from the 1945 low of 12.6 billion kwhr, we went to 17.5 in 1946, 20 in 1947, 22 in 1948, until 1951 saw a total of over 29 billion, which will again be exceeded this year.

CURRENT PROBLEMS

After this historical summary, let me give you a closer look at some of the problems now facing our industry. I would like to begin with some figures. The total installed capacity at the close of 1951 was over 9 million kw: 7.5 million of which represented hydroelectric stations; 260,000 kw, geothermic units at Larderello; and the remainder steam-power units.

The national output for 1951 was 29.3 billion kwhr, 26.5 billion hydroelectric and the remainder geothermic and thermoelectric.

The aggregate storage capacity of the seasonal reservoirs is 81 billion cu ft, the equivalent of approximately 3.5 billion kwhr.

In regard to geographic distribution of power generation, almost three fourths of the power is generated and consumed in Northern Italy. While per-capita yearly consumption is between 850 and 900 kwhr in Northern Italy, in the same range as

The 1952 Calvin W. Rice Lecture, presented at the Semi-Annual Meeting, Cincinnati, Ohio, June 15–19, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. (Owing to the illness of Dr. Ferrerio, the address was read by Giorgio Valerio, vice-president, Italian Edison Company, Milan, Italy.)

most other industrialized European countries, it varies between 200 and 100 kwhr in the southern part of the country and in Sicily and Sardinia. This great difference reflects the deep disparity of industrial and economic structure, and therefore of income, existing between the different areas of Italy. Naturally, the low consumption in the south increases the cost of power because of the higher distribution costs.

In addition to this, transmission and distribution are made more costly by the mountainous nature of much of our territory and by a widely dispersed rural population. For instance, we have in the Edison Group of companies 1.94 miles of medium or high-voltage transmission lines for every million kwhr we sell yearly; the same ratio for two American power companies that are best suited for comparison is 0.72 and 0.52. This means, within the limits of the instances given—which we think are well representative—that to sell the same amount of power in Italy, transmission lines must be built from 3 to 4 times longer than in the United States.

As I have already said, the Italian power economy has been and still is now prevalently hydroelectric. It has been common in the past few years to repeat how fortunate it was for Italy to be able to develop water power for its industrial requirements. It is indeed lucky, because these hydroelectric resources enable us to compensate at least in part for the lack of any other appreciable source of energy in the country. But these natural resources require, in order to be placed at man's service, higher investments and expenditures than those needed in other countries.

The water flow of Italian streams varies widely from month to month and from year to year, with large variations both in low-water and flood stages. This situation calls for the construction of very large reservoir capacities, suitable for daily, weekly, and seasonal regulation of the flow. It is easy to realize how this type of exploitation has raised costs.

One other cost-increasing factor is the comparatively small plant size imposed by geologic and surface characteristics of the land. In the United States, Canada, or Sweden, it is possible to build large projects with low unit costs; Switzerland itself offers more favorable geologic conditions and with more extensive glaciers and snow banks has the benefit of more uniform rates of flow.

All these special conditions and considerations have a direct influence not only on costs of construction and operation, but on engineering principles as well.

In countries that have abundant water, hydroelectric installations are built on the principle of the lowest cost, even if this results in incomplete utilization of the available resources. Elsewhere, if the steam-power installations are predominant, their unit cost serves as comparison and determining factor to control the exploitation of hydroelectric resources. In Italy the tendency has always been to push the exploitation of water resources to the limit, because steam-power generation, besides calling for large amounts of valuable foreign currency with which to purchase equipment, is made expensive by the high cost of fuels, all imported.

I can offer as an example the exploitation of the Toce valley, near the Simplon Tunnel. The total surface of the basin is 127 square miles and it yields 970 million kwhr a year. Thirteen "heads" have been obtained and nine reservoirs built, with a capacity of 38.5 million cu ft of water, the equivalent of 450 million kwhr. Practically all the rainfall of the whole year is exploited.

The hydro resources of the majority of the Alpine and Apennine valleys are exploited under the same principle, although not always to such an extent.

In addition to the described geophysical factors that made the exploitation of hydro power in Italy inherently expensive, there are other factors, more of an economical nature, that contribute to further increase costs. Among these are the higher cost of raw materials and of capital, the latter being one of the most important items in determining the cost of hydroelectric installations. The cost of capital in Italy is almost three times as much as in the United States.

As a result, the investment required by the cheapest Italian plants in the Alps and Apennines is roughly 50 lire for yearly kwhr, as against 12 to 20 lire in Sweden, Norway, or the U. S. A., and 40 lire in France. Faced by these unfavorable conditions, our power industry must keep to what we might call a "technique" of minimum expenditures, using every technical and administrative device that may contribute to lower production costs, without lowering the standard of service.

For instance, in the field of dam design, solid gravity dams have progressively been abandoned in favor, whenever possible and convenient, of single- or double-curvature arch design, arch gravity design, or cellular gravity design. In addition to the well-known technical advantages afforded by these solutions, fundamental among them the reduction of uplift, they have made possible savings in cost that vary with the locations and with the height of dams, but that have been as high as 30–32 per cent.

Technical innovations were also achieved in the design of intake works and reservoir discharge works (for instance, vortex shaft spillways for uniform hydraulic performance), in the design of sand traps where water is taken from rivers or streams, of pressure tunnels and penstocks. In an effort to save steel, penstocks have been drilled in solid rock, thereby combining the resistance of rock and steel to withstand water pressures. Frequent use is made in Italy of underground stations; where by shortening the length of penstocks, it is possible to accomplish further savings in steel.

More progress has been made in the study of chemically resistant cement, of concrete, and in the procedures for mixing and laying concrete in the construction of large dams.

NEED TO DEVELOP STEAM POWER

All the special conditions that I have mentioned will influence the future development of the Italian power industry. On one hand, our hydroelectric resources are rapidly being exhausted to a point where in about one year we shall have exploited two thirds of the heads economically available. On the other hand, the demand for power is continuing to grow. Our main problem, therefore, remains that of developing more power without relying mainly on hydro resources. The only way out is to plan more and more steam-power stations.

However, an increased recourse to steam power compels us to face delicate problems. Italy is notoriously lacking in coal and oil: An increased power output based on coal-fired stations would badly worsen the Italian currency balance. It is lucky that natural-gas resources of considerable extent have been recently tapped in Italy, with favorable indications of future production.

At present all activity in the natural-gas field is practically concentrated under a Government monopoly, which among other things seems to follow a discriminative policy between consumers and a price policy that certainly does not encourage increased consumption.

A few large steam-power stations are now being built (Piacenza and Tavazzano, 120,000 kw each), or are being planned, that should burn domestic natural gas.

It is therefore understandable that our industry should be greatly concerned with the problem of the exploitation of the Italian natural-gas resources. We have been maintaining that

(*Continued on page 739*)

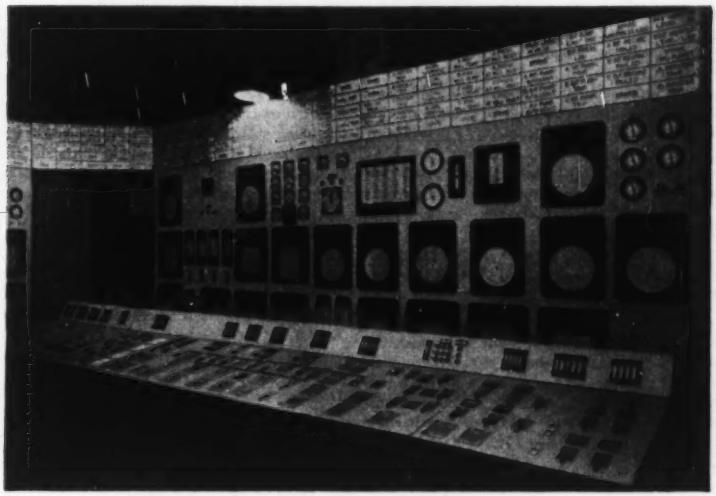

FIG. 1 FULL-SCALE MODEL OF MERAMEC PLANT-CONTROL BOARD

New Features of STEAM PLANTS *on* INLAND RIVERS

By G. V. WILLIAMSON

STEAM ENGINEERING SUPERINTENDENT, UNION ELECTRIC COMPANY OF MISSOURI, ST. LOUIS, MO.

THE tremendous expansion in steam-electric generating capacity is bringing more new plants into service than ever before, and every feature of them is of interest to the designer and operator. To reduce the burden on the student of power-plant design, this paper attempts to cover only new or unusual features considered significant in some of the new capacity in the author's experience. It happens that some of these new features could be of interest anywhere, other features will have significance to those burning coal from the Midwest area, while some may interest only designers or operators of plants on inland rivers where river stage varies widely. In any event, the pressure of providing greatly expanded generating facilities quickly, for high economy and dependability, and for low investment and production cost has called for sound and ingenious designs worth reporting.

STEAM-ELECTRIC PLANT DEVELOPMENT

Let's stop first to outline the significant aspects of this country-wide steam-electric plant development. Three features have been widely discussed as follows:

1 The amount of expansion.

2 High steam temperatures and resuperheat.

3 Elimination of building walls to reduce cost or increase comfort of operators.

All three of these aspects are eminently represented in plants here discussed, Venice II, Meramec, and Joppa; the first two in the Union Electric System of St. Louis, and the latter owned by Electric Energy Incorporated, of which Union Electric is a part owner.

The last two Venice II boilers were among the first supersize units of over a million pounds of steam per hour. Ordered in 1948, and in operation in 1950, they are the first to demonstrate the practicability of such size in a single furnace using Midwest coal, namely, Illinois coal. After 18 months of service they have demonstrated capacity up to 1,100,000 lb per hr with 12 per cent ash coal which slags at 2000 F without fouling of furnaces or superheater passes. The designer's solution, responsible for this success, is a furnace sized not on the basis of a number of Btu per cu ft of volume but on the basis of 70,000 to 84,000 Btu per sq ft of furnace-wall area. This approach, achieved, in this case, with a divided wall furnace, has assured a furnace exit-gas temperature below the ash-fusing point.

Then, as to size, the Meramec boilers quickly went a step larger to 125,000 kw (110,000 kw at Venice II) and the Joppa boilers to 160,000 kw or more. Joppa, with over 600,000 kw

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in four boilers burning 2,500,000 tons of coal per year, is a supersize plant with all four units coming on the line soon. Its annual kilowatt-hour output will equal roughly that of the Union Electric System in 1951.

In steam temperature, Joppa at 1050 F and 1000 F resuperheat is among the top. Meramec, as a cautious approach to the slagging of superheater surface, was this company's first reheat plant at 950–950 F.

In building walls, Meramec is of the semioutdoor type, and Joppa will be among the first all-outdoor plants of large size this far north.

Now there are three other developments in recent steam-plant design that have not been discussed so widely, although in the over-all scheme their significance may equal that of the first group. These are as follows:

4 Operation of boiler-turbine unit and all its essential auxiliaries from a compact central control room.

5 Large capacity in a single turbine-boiler, 100,000 kw, and up being a common size of unit.

6 Radical simplification of cycle, eliminating many items of piping, variable-speed drives, and duplicate auxiliaries, once all thought essential.

The central control room at Meramec, Fig. 1, was developed carefully with compactness as an essential, but with a full complement of controls and recording instruments under the operator's eye. This control room in itself merits a detailed description, but suffice it to mention that the board for turbine, boiler, ash-handling, and essential electrical switching is but 18 ft long It is the set-forward bench type giving full view of recorders on steam-air flow, steam pressure, steam temperatures, drum level, and the like. Joppa will have one of the extremely compact "graphic" boards with flow diagrams and equipment in outline, and recording instruments on the panel back. It will be of interest to see which type will be preferable in equipment of such size.

STILL LARGER PLANTS IN PROSPECT

The successful development of an adequate design basis for the supersize boiler on lower-grade coal has opened the Midwest area for the single boiler-turbine development in units of 125,000 kw and up, and with resuperheat. It so happens that the Union Electric System, long an isolated one with only limited interconnection, will in 1952 be interconnected north into Illinois, west to Kansas City, and southward to Joppa and the TVA. Thus there is the fortunate combination of incentive for really large units, interconnection to make them acceptable, all following the development of an adequate furnace design for the coal available. Unit size well over 200,000 kw appears to be in the immediate future.

The incentive for large-size units is derived principally from the lower cost per kilowatt of installed capacity, the economic possibility of genuinely adequate controls, and greater productivity from operating personnel. As a measure of construction-cost savings, the author's analyses bear out the size-cost rule, believed to be first expounded by M. K. Drewry,[1] that cost per kilowatt varies as the cube root of the number of units. Thus a plant with one 160,000-kw turbine-boiler unit would cost half that of a like-size plant with eight 20,000-kw units. More typically, the cube root of 2 is 1.26, or a 160,000-kw unit would cost 26 per cent less than two 80,000-kw units. Thus at Venice II, fourth section, savings due to one boiler per 100,000-kw turbine has been estimated as in Table 1.

TABLE 1 SAVINGS DUE TO TWO BOILERS AT 100,000 KW EACH RATHER THAN FOUR, VENICE II

1	Shortened boilerhouse, 60 ft	$ 500000
2	Lower cost of boilers erected	285000
3	Reduced ductwork	99000
4	Fewer draft fans	24000
5	Fewer fly-ash precipitators	110000
6	Reduced combustion controls	20000
7	Fly-ash-removal equipment	70000
8	Soot-blowing lines	11000
9	Stack-ash removal	20000
10	Boiler-feed piping	40000
11	Blow-off and miscellaneous piping	20000
12	Instruments and controls	80000
13	Two versus four stacks	55 000
	Total	$1334000

PLANT SIMPLIFICATION

What in many ways is the most interesting of all steam-plant developments, and perhaps least discussed in technical writings, is the matter of simplification, elimination, and reduction in use of spare auxiliaries that has taken place in plant designs of the past 20 months. This double philosophy applies: "Save the cost in the first place; save its maintenance and operation to the end." It is properly achieved, however, only by three types of study, all of which call upon both designer and opera-

[1] Chief Engineer of Power Plants, Wisconsin Electric Power Company.

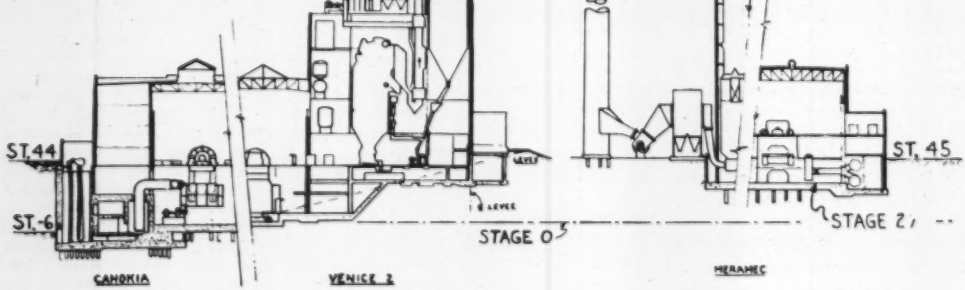

FIG. 2 CROSS-SECTIONAL VIEWS OF CAHOKIA, VENICE II, AND MERAMEC PLANTS SHOWING ELEVATION OF CONDENSER FLOORS RELATIVE TO RIVER STAGE

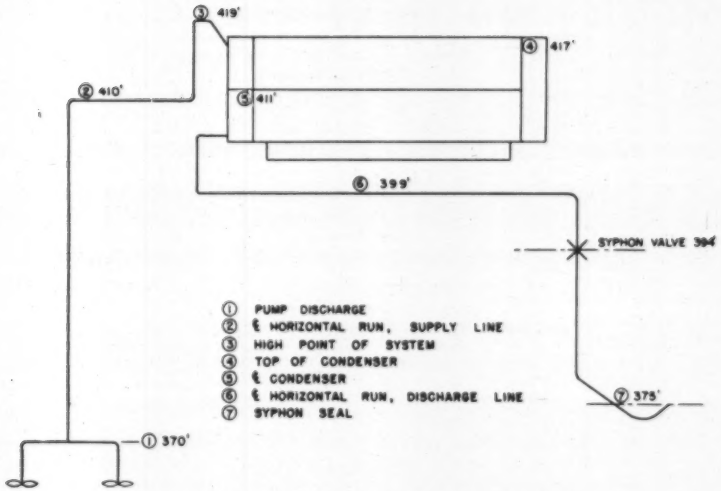

FIG. 3 SCHEMATIC DIAGRAM OF MERAMEC CIRCULATING-WATER SYSTEM

tor for the closest exchange of facts, records, and ideas. These are:

1 A careful economic development of effect of simplification on first cost, possible loss in plant efficiency, and operating costs of attention and maintenance.

2 Elimination of spare auxiliaries only after the most careful examination of records to show that virtually no loss of dependability results. After all, the aim is really more kilowatt-hours per dollar.

3 Careful examination of operating methods and results to show that many things one thought of as essential, and later "nice to have," can be eliminated, and sometimes in the process remove a liability.

ECONOMIC STUDIES

This is one of the design-operating engineers' most difficult tasks, so difficult that sometimes a decision leads the study. One such pertinent and perhaps simpler examination at Meramec was the elimination of all variable-speed drives such as on boiler-feed pumps, draft fans, and circulating-water pumps. This was simply a matter of balancing first cost, maintenance, and attention against losses resulting from increased auxiliary power use and increased wear of the auxiliary due to continuous operation at full speed. Surprisingly, no economic study at Meramec supported a variable-speed coupling or motor.

A considerably more far-reaching economy at Meramec stemmed from a careful balance between foundation costs on one hand, against raising condenser elevation above the syphon height. In so far as the author knows, this is the first major plant on an inland river so arranged, and it makes a story of considerable interest.

The Mississippi at St. Louis varies about 50 ft from extreme low stage to historic flood heights. Normally, the condenser top is placed 30 ft above lowest river stage, a syphon of 30 ft of 100 F water being about equal to a low barometer. Typically, Fig. 2, at the earlier Venice and Cahokia plants, this has meant placing the condenser-pit floor about 6 ft above lowest river stage, and 44 ft below flood levels. The result is an expensive foundation, whether the plant is built in the river with scour protection as at Cahokia, or behind a levee with intake caissons, as at Venice II.

Foundation expense not only comes from the deep excavation and unwatering problems, but from the need for waterproof membranes within the concrete walls, and the pouring of 6- to 10-ft concrete mats to offset the floating effect of a high river. Prior to Meramec,[2] however, it was believed essential as well as economical to observe the 30-ft syphon requirements.

Three developments nullified these beliefs:

1 The practicability of introducing water at the top of a two-pass condenser, out the bottom, without starving top tubes; this was found entirely feasible in Venice II, fourth section.

2 Development of hydraulic conceptions of what happens when theoretical syphon height is exceeded.

3 Development of a protection against loss of syphon. The latter two points bear expanding.

The basic conception of syphon action as conceived for Meramec comes from calculations as to absolute pressures at all parts of the circulating-water system, this absolute pressure never to be negative; and the conception that if the pressure does become negative the loss of syphon is not sudden, dramatic, and complete, but rather that the water develops an aerated or "soda-water" aspect which allows some seconds for corrective steps.

Fig. 3 and Table 2 show a diagram and data of the Meramec elevations and absolute pressures in the circulating-water lines and condenser at critical points. These indicate that at the condenser-top position of 417 ft above mean gulf level, with the friction added in the system and a barometer equivalent to 15 psi, there is a margin of 1.4 psi to protect the syphon; or the syphon would be protected at a barometer of 13.6 psi; or the seal could be safely dropped 3.2 ft with a 15-psi barometer. Actually, the seal is to be made adjustable so as to utilize fully

[2] Recognition should be given to the Dills Bottom arrangement wherein high condensers are combined with waterwheel recovery of circulating-water static head. This appears to be possibly an economical arrangement at very great differences in river stage—say, 80 ft and over.

TABLE 2 MERAMEC OPERATING DATA

Point no.	Elevation ft	Elevation head, psi	Friction head, psi	Elevation + friction hd, psi	Absolute pressure, psia
		CASE I TWO PUMPS OPERATING			
		(From Point 7)			
7	375	0	0	0	15.0
6	399	−10.4	1.0	− 9.4	5.6
5	411	−15.6	2.0	−13.6	1.4
					Min. margin
4	417	−18.2	4.6	−13.6	1.4
					Min. margin
3	419	−19.0	7.2	−11.8	3.2
		(From Point 3)			
2	410	3.9	1.0	4.9	8.1
1	370	21.2	2.0	23.2	26.4[c]
Total	+5	+ 2.2	9.2	11.4	= Pump head
		CASE II ONE PUMP OPERATING			
Point no.	Elevation ft	Elevation head, psi	Friction head, psi	Elevation + friction hd, psi	Absolute pressure, psia
			(From Point 7)		
7	375	0	0	0	15.0
5	399	−10.4	0.2	−10.2	4.8
5	411	−15.6	0.5	−15.1	−0.1
4	417	−18.2	1.2	−17.0	−2.0
3	419	−19.0	1.8	−17.2	−2.2[a]
			(From Point 3)		
2	410	3.9	0.2	4.1	4.1[b]
1	370	21.2	0.5	21.7	21.7[b]
Total	+5	+ 2.2	2.3	6.7	= Pump head
	Friction introduced by valve		+2.2		
			4.5		

[a] Minimum friction required from syphon valve, 2.2 psi.
[b] Assuming operation of syphon valve to increase friction head 2.2 psi giving zero absolute pressure at point 3.
[c] Plus river elevation below seal.

any such margin. Finally, in the event one pump is lost and friction drops by as much as three fourths (the fall would be actually less), the siphon can be protected by closing the butterfly syphon valve partially so as to add 2.2 psi of friction artificially, thus collapsing incipient bubble formation.

In short, by calculating the effect on the syphon from friction in the circulating-water system (including condenser tubes of course) the point of lowest absolute pressure can be found and the seal elevation established for a protected syphon. In the event of the loss of a pump or other untoward condition, the syphon can be protected by artificial friction in the form of a large butterfly valve.

By tentatively setting the seal at an elevation of 375 ft or but 2 ft above the "zero" river stage and 8 ft above record low river, the entire foundation problem has been vastly lessened at the expense of a maximum of 8-ft loss in pumping head. Because the river is above elevation 375 ft some (90 per cent) of the time, the over-all effect on pumping power is slight. By this approach, the lowest elevation of this plant was set at almost exactly that of the yard as found (400 ft elevation), waterproof membranes and heavy slabs have been eliminated, and a saving of well over a million dollars was effected on the first of four ultimate units.

Other phases of Meramec reflect a similar modern approach in economic design. For example; building walls are of steel "Galbestos" at a cost 40 per cent below aluminum, and 70 per cent under brick. Tile floors in the turbine room have been eliminated as unnecessary, as a hardship to those walking over them, and as a nuisance during turbine overhauls. All skylights have been eliminated, glass maintenance having proved to be substantial. There will be no ornamental gate house. The crane rail is but 2 ft higher than required to clear a 200,000-kw 3600-rpm unit.

CONCLUSION

In conclusion, it seems apparent that the postwar designers and operators of steam plants are achieving excellent results in simplifying steam plants and lowering construction costs, while paying full attention to safety, dependability of operation, and low power-production costs. The results are being achieved by determined questioning and examination of each phase of plant layout and equipment. The industry is showing more evidence of its past vision in imaginative and constructive engineering.

PRODUCTION of what is said to be the largest steel ingot ever made in Great Britain is reported in *Engineering*, July 11, 1952. It was produced by the English Steel Corporation, Ltd., of Sheffield, England, at their River Don Works. The ingot is 26 ft long and 9 ft across the largest octagonal section, and required 270 tons of special steel from four acid open-hearth Siemens furnaces. Apart from the high technical skill required in the casting of such a large ingot, lifting and transporting it set many problems.

Two cranes, coupled by a specially constructed lifting beam, were used; and, to insure co-ordination of lifting and perfect teamwork in other phases of the operations, several rehearsals were necessary, a smaller ingot of 210 tons being used for this purpose. When stripped from the mold, the ingot was loaded onto a 300-ton 24-wheeled railway bogie, built for the English Steel Corporation for the internal transport of large ingots, forgings, and castings, and was taken for further processing.

The ingot will be forged under a 7000-ton electrohydraulic press at the River Don Works into a single hollow-forged boiler drum. When finished, the drum will be 42 ft long, 6 ft 2¼ in. OD, and 5 ft 6 in. bore.

THE ASME BOILER CODE

III—The Administration of the First Code—1915–1918

By ARTHUR M. GREENE, JR.

PRINCETON UNIVERSITY, PRINCETON, N. J. HONORARY MEMBER ASME

THE first ASME "Rules for the Construction of Stationary Boilers and for Allowable Working Pressures," known as the edition of 1914, was finally adopted in the spring of 1915 as described in chapter 2 of this history. The enlarged committee, now known as the Boiler Code Committee, was to administer this Code subject to the final approval of the Council of The American Society of Mechanical Engineers, and was to provide interpretations, rulings, revisions, and additions. Many revisions were to be made after public hearings, held at intervals of about four years.

As the administration of this first Code established methods of procedure, introduced the formation of subcommittees of experts, consisting of some of its members and some nonmembers, for advice and guidance, and called for special hearings on disputed questions which required clarification, this chapter includes many details which indicate the variety and volume of the work undertaken by the Boiler Code Committee and the manner in which the Committee set about discharging its duties.

THE COMMITTEE TACKLES ADMINISTRATION OF THE CODE

Before the first meeting of the enlarged Boiler Code Committee of twenty-four members, representing various activities interested in safe boiler construction, the Council of The American Society of Mechanical Engineers acted on Code matters brought to its attention. On April 9, 1915, it voted (item 742), in response to a letter from John A. Stevens, requesting the completion of the Boiler Code, that (*a*) the entire Boiler Code Committee be requested to make its own suggestions of changes, omitting the request that the Council sanction any work on laws, and (*b*) that authorization to use the Code symbol be referred to the Boiler Code Committee for recommendations and report to the Council. At a previous meeting of the Council any legislative body was authorized to publish the Code when adopted, and by item 710 it referred the printing of the Code to the Executive Committee of the Council and the Finance Committee of the Society. The price of single copies of the Code to members and to nonmembers and the prices for large quantities were to be fixed by these committees.

In it m 734 a letter from Samuel M. Green objecting to the Boiler Code report is recorded with the comment that after full discussion it was the sense of the Council that the report of the Boiler Code Committee had been properly presented and issued by the Society.

The first meeting of the Boiler Code Committee after the adoption of the Code by the Society was held on June 23, 1915, at the Statler Hotel, Buffalo, N. Y. Chairman John A. Stevens, Secretary C. W. Obert, and Messrs. Clark, Durban, Fisher, Gorton, Hammond, Huston, Jacobus, Jeter, MacGregor, Moore, and Reed, were present. The Committee adopted resolutions to be presented to the Council asking it to approve the statement that the Code symbol applied to a boiler would indicate that the boiler had been built in full compliance with the Code and that the stamp should be applied by the manufacturer. It asked permission to make rulings respecting constructions not covered by the Code and to interpret any part of the Code. It also asked for authority to consider the subjects of economizers, pressure vessels, rules for the care of steam boilers, and the section on recommended practice for the future editions. These subjects had been omitted in the Code of 1914. The Council gave assent to these requests at its meeting of the same day, and asked that the Committee report its actions to the Council and that consideration of model laws be omitted from its activities. A recommendation relating to deletion from the Code of the statement of its nonapplicability to boilers of railroads was referred to F. W. Clark.

At the meeting of the Boiler Code Committee on June 24, 1915, the procedure to be followed in making interpretations of the Code was formulated in a report of a committee consisting of Messrs. Stevens, Jacobus, Jeter, Fisher, Gorton, and Reed. It was ordered that any opinion or reply to correspondence which might be considered a decision was to be given a case number as it would establish a precedent or guide for future similar action. Cases were to be held separate from general correspondence. All case matters together with the final decision were to be sent to each member of the Boiler Code Committee with a reasonable time allowance for examination, criticism, and approval before the ruling was sent to the inquirer. The secretary, C. W. Obert, was directed to care for the correspondence of the Committee.

DETAILS OF THE FIRST TEN CASES

The Committee considered cases 1 to 10 at this meeting; and since these early cases indicate their nature and the procedure of the Committee in carrying out the objects of the Code, each of them will be given in some detail.

Case I was an inquiry from H. V. Neff regarding the stresses and staying of a special form of portable vertical boiler, the Tudor boiler. After discussion the following reply was formulated:

> The Boiler Code Committee of the ASME in reply to your communication of April 9th, 1915, would say that the strains in the Tudor boiler cannot be calculated and we should be very glad to see such a boiler of particular size and make tested to destruction in the presence of the Ohio State inspectors and the inspector of an authorized insurance company doing business in the State of Ohio.
>
> We would appreciate the complete results of their destructive test sent to Mr. C. W. Obert, Secretary of the Boiler Code Committee, the ASME, 29 W. 39th Street, New York City, in 25 copies, for the members of the Boiler Code Committee, who will of necessity all have to review the results of this test before we can give you an empirical formula for the calculation of this particular boiler, or its safe working pressure. We might add that any decision given would be on the particular and exact design as tested, and should this boiler be constructed of known material, the test will be of exceptional value.

Third chapter of a history of the ASME Boiler Code, prepared for the Boiler Code Committee of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chapter 1, which dealt with the antecedents of the Code, appeared in MECHANICAL ENGINEERING, 1952, pp. 555–562; and Chapter 2, which told how ASME set up the Committee and adopted the first Code of 1914, appeared in 1952, pp. 640–646.

This test to destruction was suggested by Par. 247 which provided for the tests of cast-iron headers to destruction. By interpretations the paragraph was changed to include such tests of complete structures and in the edition of 1918 Par. 247 reads as follows: "Where it is impossible to calculate with a reasonable degree of accuracy the strength of a boiler structure or any part thereof, a full-sized sample shall be built by the manufacturer and tested to destruction in the presence of the Boiler Code Committee or one or more representatives of the Boiler Code Committee appointed to witness such tests."

Case No. 2, from the G. T. Ladd Company, was a request for a ruling as to the method of supporting water-tube boilers by head supports attached directly to the drums. The reply stated that where additional loads were placed on parts of a boiler these must be considered, and additional strength provided, using a factor of safety not less than that given in the Code.

Case No. 3, from H. V. Neff, asked if flange steel could be used in shells of certain boilers under the ASME Code. The reply stated that in accordance with Pars. 2 and 3 flange steel may be used in shells of such boilers.

In Case No. 4, from H. V. Neff, the Committee replied that although the Code did not mention or provide for the return products of combustion passing over the tops of horizontal-return-tubular boilers, nevertheless when such is the case fire-box steel must be used as required by Pars. 2 and 3 of the Code.

Case No. 5, from the American Hoist & Derrick Co., referred to the use of a particular design of a quadruple-riveted butt and double strap joint under Code rules. The reply stated that there was nothing in the Code to prohibit the use of such arrangement providing rules of Code with respect to joints were complied with.

Case No. 6, from the Erie City Iron Works, referred to the upper cut on page 103 of the Code, and called such a joint as illustrated impossible for boiler construction. The reply stated that the criticism was justified only when butt straps were thin. The type shown on page 103 was in common use in this country and abroad with heavy plates.

Case No. 7, from the E. Keeler Co., referred to the use of bushings specified in Pars. 307 and 315 and asked if these were considered necessary to more securely hold the pipe to the head, and if so, did not a lip pressed outwardly around the feed pipe perform the same function and could it not be included under the same specification. The reply stated: "the flat part for the bushing would be better construction, but the bushing is required to allow the pipe to be threaded in tightly from each side."

Case No. 8, from A. B. Farquhar Co., criticized the title of the Code. Since the Code referred to portable, semiportable, and traction boilers, the company thought the expression "Construction of Stationary Boilers" was incorrect. The Committee replied that the word stationary had been used to distinguish between land boilers and marine boilers and also it referred to boilers not used for propulsion.

Case No. 9, from Prof. W. H. P. Creighton, covered a request to publish extracts from the Code in a textbook, and in reply the Committee stated that this was not allowable.

Case No. 10, from the Erie City Iron Works, asked where the stamp specified in Par. 332 of the Code might be obtained. The reply stated that these stamps could be obtained through ASME at a price of $3 each.

The number of cases considered during this year, from June 23 to Dec. 9, 1915, totaled 45, and came from boiler manufacturers, manufacturers of accessories, steel manufacturers, insurance companies, mechanical engineers, and steam-shovel and thresher manufacturers.

The first ten rulings were reported to the Council at its meeting on Oct. 8, 1915 (item 828 *a*), and the Council voted to rescind its action of June which granted authority to the Boiler Code Committee to make final decisions as to interpretations of the Code. It voted (item 829) that the Boiler Code Committee be empowered to make rulings when inquiries were made respecting construction not covered by the Code and to interpret any part of the Code, but the actions on all rulings made by the Committee were to be reported to the Council and approved by the Council before being issued.

In item 830 the Council authorized its Executive Committee to exercise the authority of the Council in the interim between Council meetings when delay in issuance of interpretations would be detrimental to the boiler industry. Thus began the practice of issuing interpretations after approval by the Council, its Executive Committee, or, as the By-Laws of the Society have been changed, by some agency of the Society established for such purposes. Throughout the activities of its life of almost forty years, decisions of the Boiler Code Committee have been, in fact, actions of The American Society of Mechanical Engineers. The minutes of the Council throughout these years contain the record of these approvals by case numbers, in most instances coupled with the authorization of publication.

Approval of the interpretations of cases by the Council made them official, and later when revisions or additions of certain paragraphs were made between editions of the Code, the Council added to their approval an order to print the words "and are adopted as Standard Practice."

AUTOGENOUS WELDING

The matter of gas and electric-arc welding in use for building steel structures and ships was brought before the Committee at this first meeting. Robert Cramer presented many samples of the work of his company using oxyacetylene welding. These were of great interest, but no opinion was expressed by the Committee as to the application of such welds. Mr. Cramer stated that the art was new and that his organization was proceeding with speed to develop the process before approaching the Boiler Code Committee for any decision.

FIRST SUBCOMMITTEE APPOINTED

On Sept. 27, 1915, the Committee with 14 members present considered a second printing of the Code of 1914 with index and the correction of typographical errors but without other changes. This was followed by consideration of cases 11 to 32; and for one of them, Messrs. Clark, Vaughan, Kiesel, Jeter, and Humphrey of the Committee, and John Wynne a nonmember, were appointed as a subcommittee to consider locomotive boilers not under federal control. Thus began the practice of the Boiler Code Committee to secure Council approval of subcommittees for definite purposes and composed of members and nonmembers of the Boiler Code Committee who were specially fitted for the work by their training and experience.

FIRST INTERPRETATIONS APPROVED BY ASME COUNCIL

At the Council meeting of Nov. 12, 1915, Professor Greene, representing the Committee, read to the Council the interpretations to date, cases 1 to 35, inclusive. These were received and approved for publication in *The Journal* and release of the interpretations was ordered. Publication in *The Journal* resulted from many requests from interested parties and because it was deemed advisable to give the interpretations of the Boiler Code Committee wide publicity.

FIRST REOPENING OF CASES

At the Committee meeting of Oct. 27, 1915, in addition to 13 members, three nonmembers were present by invitation to

discuss certain cases or give desired information, a practice of the Committee which still continues. At this meeting it was decided to reopen certain cases on which adverse replies had been received from members, another practice which developed during this first year of Code administration.

At this meeting Case 11 was reopened and explained. A ruling was made that the pitch of tube holes in the drum design submitted did not come within the range of the formula of the Code and these particular spacings and sizes of tubes may be figured on longitudinal lines. The reopening of Case 17, with further explanation, disclosed that no special ruling was necessary. In reopening Case 35 by the Penberthy Company, Mr. Lawson, an invited guest, showed the difference between the usual makes of water glasses and those of his company, and contended that these differences warranted a change in Par. 292 so that his company's water glasses could be used. He was asked to suggest the change that could be made. This led to a ruling in interpretation of this paragraph.

The reopening of Case 13 resulted in the preparation of a new figure (called Fig. 3) in which the application of Pars. 205, 206, and 207 to eight possible cases where uncertainty might arise in the staying of locomotive-type wet-bottom boilers. With each illustration, a reference to a Code paragraph and a formula for the value of p was made and also the value of the constant in that formula. This figure appears in the appendix of the printing of 1918 as Fig. 32 and is noted between Pars. 206 and 207.

COMMUNICATIONS

At this same meeting a communication from the Bigelow Company was considered. This communication did not warrant a case number because a reply by letter would give the necessary information. This was one of the earliest examples of the so-called "Communications" to be found in the minutes of the Boiler Code Committee.

The meeting of Dec. 9, 1915, was attended by 11 members. The Committee reopened cases 16, 23, and 24, and received a report from Thomas E. Durban of his activities in connection with the American Uniform Boiler Law Society which was being organized as a continuation of the Uniform Specification Committee of the Boiler Manufacturers Association. He spoke of the large expense that he was under in an attempt to promulgate the ASME Code. Many copies had been sent to interested parties in different states and to all colleges and educational institutions, such as Virginia Polytechnic Institute, University of Texas, and Georgia School of Technology.

Professor Greene reported that he was using the Code as a text in his course in boiler design at the Rensselaer Polytechnic Institute; and at a later meeting he reported that eleven schools of engineering were using the Code as one of the texts in boiler design and nine were using it as a reference.

The Council minutes for Dec. 7, 1915, record a communication from Henry Hess, concerning a letter from the American Uniform Boiler Law Society. The Council voted that this subject be continued in the hands of the secretary. At the meeting of the newly elected Council on Dec. 10, 1915, approval was given to eleven interpretations and they were ordered issued. The secretary was requested to send future interpretations to members of the Council in advance of the meeting at which they would be considered.

At the Council meeting of Jan. 14, 1916, the membership of the Boiler Code Committee as constituted was continued for one year. This is the first of such entries to be found in the minutes of the Council or its Executive Committee at the beginning of each year, which again clearly indicates that the Committee is a creation of the Council to which it is answerable for interests, activities, and interpretations.

The meeting of the Committee on Jan. 14, 1916, considered two new cases, two reopened cases, and two communications. One of these communications was a protest from the American Society for Testing Materials relative to the references in the Code to their material specifications and the changes which had been made in their printing in the Code. It was pointed out that the Code must use a definite specification and could not refer to any new one not yet included in the published Code. It was shown also, that automatic reference was not possible and that only after approval by the Council could changes be made.

STEVENS CONTINUED AS CHAIRMAN

At this meeting, John A. Stevens, who had been elected a member of the ASME Council, resigned as chairman of the Committee. This matter was discussed after he had retired and the following resolution, proposed by Mr. Gorton and seconded by Mr. Jeter, was adopted:

"RESOLVED, That the members of the Boiler Code Committee, appreciating the untiring energy and service of Mr. Stevens in formulating the Boiler Code, request him to withdraw his resignation and remain Chairman of the Committee."

The resolution received unanimous approval and by motion of Mr. Fisher, seconded by Mr. Kiesel, it was voted that the resolution be published and that Messrs. Fisher and Jeter escort Mr. Stevens to the Committee room.

At the meeting of Feb. 11, 1916, with ten members present, 11 cases and some miscellaneous letters were considered. Dr. Edgar Marburg and A. W. Gibbs of the American Society for Testing Materials, explained their position and desires and appealed from the reply given to the communication acted upon at the January meeting of the Committee.

The meeting of March 10, 1916, was attended by nine members. Seven cases were considered. F. C. Clark reported on the status of the Subcommittee on the Code for Railway Locomotive Boilers which had been appointed Sept. 27, 1915, to consider locomotive boilers not under federal control, to the effect that the code was in the hands of John Wynne of the American Locomotive Company.

At this meeting another objection was received from John C. Parker regarding the limit of 160 psi pressure on boilers equipped with malleable-iron headers. The Committee could offer no change, although at a later meeting this subject was submitted to a subcommittee for investigation and report.

OBERT CONTINUED AS SECRETARY OF THE COMMITTEE

C. W. Obert, secretary of the Committee since the early work on the Boiler Code, announced that he had been appointed secretary of the American Society of Heating and Ventilating Engineers and planned to retire from the office of secretary of the Boiler Code Committee. This was greatly regretted, and the Committee passed a resolution of appreciation of the work Mr. Obert had done for the Boiler Code Committee.

The importance of the services of Mr. Obert was so great that an endeavor to retain them finally resulted in his continuance as secretary of the Committee on part time while still serving as secretary of the American Society of Heating and Ventilating Engineers.

On April 11, 1916, the Council of the Society referred to the President the nomination of a Committee to undertake the standardization of feedwater heaters.

The meeting of May 12, 1916, was attended by twelve members and Paul H. Talbot, a guest. Eight cases were considered. Mr. Talbot had sent in drawings of his flash boiler, and in appearing before the Committee he reported his experience in the use of boilers which differ from those carrying a definite water level. He explained the operation of his boiler but the Com-

mittee could not reach a decision or formulate rules for such a boiler.

As certain of the cases before the Committee were delayed by the need for drawings, it was decided that all inquiries made to the Boiler Code Committee should be submitted with necessary drawings for all members of the Committee or members of the Council.

CASE NUMBERING

The Committee decided that when a case was withdrawn or dropped the numbers of succeeding cases would not be changed, but the case in question would be marked annulled.

In Case 72 the gages for tubes in Par. 21 had been studied by Messrs. Jacobus, Fisher, and others with the result that gages for $3^1/_4$-in., 4-in., and 5-in. tubes were revised.

PUBLIC HEARINGS

The Introduction to the Code stated that public hearings on the Code for interested parties should be held every two years and one had been set for February, 1917. The Committee was asked if it would be well to hold such a hearing on Friday and Saturday, Dec. 8 and 9, 1916, following the Annual Meeting of the Society. It was pointed out that a public hearing might start endless discussion. Moreover, since the Committee was always accessible for hearings, this fact should be so announced in *The Journal* for the remainder of 1916 in the form of a statement to the effect that the Boiler Code Committee held monthly meetings for the purpose of considering communications relative to the Boiler Code. Any one desiring information as to the application of the Code was requested to communicate with the Secretary of the Committee.

On June 16, 1916, nine members of the Committee met and considered seven new and six earlier cases. One of the old cases was annulled, as well as three of the new cases.

The Talbot boiler, Case 49, which had been before the Committee in March and May, was still before the Committee as it could not determine how far the Code applied to a flash boiler or whether the cast-steel headers had the physical and chemical properties called for in the Code.

QUESTION OF WELDING IS RAISED AGAIN

Case 80, from the Union Iron Works of California, asked if the Committee had investigated recent methods of welding, as a great deal of time and effort had been put forth by manufacturers of autogenous-welding apparatus. The Committee was requested to give this matter further consideration.

The Committee replied that since its inception it had had under constant observation all sorts of welding of pressure vessels, and had gone so far as to ask some of the welding experts of the country to write papers for the Society to bring out further information regarding these particular processes. Suggestions for changes would be considered at the public hearing before the Committee, where all interested parties might be heard.

The Committee recommended in the Code that hearings to consider revisions be held at least once in two years and the time for the first hearing was now near at hand.

In some of the cases at this and other meetings of the Committee it had been asked to pass on the safety or superiority of designs over other structures for the same use and in all of these the reply had stated that the Committee did not pass on specific designs.

At the meeting of the Council on July 27, 1916, Dr. Jacobus, who at that time was President of the Society, restated the practice of the Boiler Code Committee to send simultaneously to all the members of the Council and the Committee every interpretation prepared at the Committee meeting. Unless there were objections, these interpretations were transmitted for approval. One dissenting vote prevented presentation of an interpretation to the Council, so that approval of every member was inferred before interpretations were presented for official consideration by the Council.

Eleven members were present at the meeting of the Committee on July 27, 1916. Seven cases were considered and two earlier cases were amended. Messrs. Jeter and Durban were appointed as a permanent committee to confer with the Massachusetts Board of Boiler Rules.

At this meeting, certain cases referred to autogenous welding and the reply given was the same as that given for case 80. During the revision of the 1918 edition autogenous welding was permitted in Par. 186 when stresses were carried by other construction and safety did not depend upon the strength of the weld. In case 89 the Committee stated that state boards or inspectors could refer inquiries to the Boiler Code Committee for rulings.

At the Committee meeting of Aug. 24, 1916, with nine members present, the Talbot boiler case 49 *b* was again postponed and Mr. Kiesel rejected the amendment to case 86

Case 93, from the Lackawanna Boiler and Grate Co., requested exemption from Pars. 186 and 187 of the Code which applied to the welding of boiler joints where electric metal-electrode or so-called "pencil-type" of autogenous welding was used, as this process was claimed to be greatly superior to any form of gas welding. The reply quoted the reply that had been given in case 80, already referred to. In objection to this reply, E. A. Wildt appeared with the welding expert, F. G. Saussure, representing the Seimund-Wenzel process, to explain the advantages and performance of the process. He stated that no boilers had been constructed by its use, but he would like the sanction of the Committee to build boilers with such welds. This of course the Committee would not do with the information available at that time.

After consideration of seven new cases, the Committee discussed the correction of errors in the first published interpretations, and the Secretary was empowered to correct grammatical and typographical errors.

The question of the return of approvals of interpretations by members of the Committee was discussed. Since records of replies were kept by the Secretary, the advisability of dropping a member who failed to return his vote on three consecutive lists was considered but no action was taken. It was finally agreed to prepare a postal form of reply on which members could vote approval or disapproval of definite cases. The Committee also arranged to provide each member with a complete file of cases at meetings of the Committee.

DECISION TO HOLD PUBLIC HEARINGS ON DEC. 8 AND 9, 1916

The Committee agreed to hold public hearings on revision of the Code on Dec. 8 and 9, 1916, and this decision was approved by the Council on Sept. 25, 1916, with the understanding that, if necessary, the hearings would be continued during the following week. The Secretary of the Society was instructed to issue invitations to those organizations which were affected by the Code and to those states and municipalities which had adopted the Code. The latter were asked to name delegates to represent them. It was also directed that announcements of the hearings appear in *The Journal* and the technical press.

PRINTED INTERPRETATIONS

At this meeting of the Committee it was agreed to send printed copies of the interpretations to the states and interested parties, and Mr. Durban stated that the American Uniform Boiler Law Society would pay the cost of at least fifty sets.

CONFERENCE COMMITTEE APPROVED BY THE COUNCIL

An advisory committee of the Boiler Code Committee, to be formed solely of representatives elected or appointed by the states and municipalities that had adopted the Code, was discussed, and was approved by the Council (item 1057) on Oct. 13, 1916, to be called the Conference Committee. The Conference Committee has proved its great worth during the years by its suggestions and aid in the formulations of replies and bringing uniformity in the application of the Code among all states and municipalities adopting this document.

The Committee appointed a new subcommittee to replace the earlier one to confer with the Massachusetts Board of Boiler Rules, to consist of Messrs. Greene, Jeter, Miller, and Reed.

A request to appoint a representative of the Boiler Code Committee to meet with the Ohio Board of Boiler Rules and the Advisory Board of the Ohio Industrial Commission at which time a joint conference of Industrial Commissions of various states would be proposed, was disapproved after remarks by Mr. Durban. Mr. Jeter had recommended sending acceptance of the invitation to J. C. Callery, chief, Board of Boiler Rules of Ohio.

The meeting of Oct. 13, 1916, was held with 14 members and several guests present. The first business was a hearing of representatives of the Association of American Steel Manufacturers regarding case 90 of the Lukens Iron and Steel Co., and representatives of the Parkesburg Iron Company in connection with case 111 of the Pennsylvania Railroad.

Case 90 related to the deletion or retention of the maximum allowable copper content of 0.25 per cent in firebox steel. The Association of American Steel Manufacturers was represented by Ashton D. Peace, Central Iron & Steel Co.; James P. Roe, Glascow Iron Works; John W. Logan, Alan Wood Iron Works; and Elwood T. Ickes, Worth Brothers Co. These representatives presented arguments to show that the copper-content requirement for firebox boiler plate should be eliminated. Letters were also received from F. A. Robbins, secretary of the Association of American Steel Manufacturers, F. J. Cole of Committee A1 of ASTM, and James Neil, member of the Conference Committee of the Boiler Code Committee and superintendent of boiler inspection of the State of Pennsylvania, which asked for modifications. This discussion covered much ground and case 90 was postponed until the public hearing of Dec. 8 and 9, at which time the copper reference was eliminated from steel-plate specifications.

Case 111 referred to the flange test for boiler tubes, and after hearing from James A. Kinkead and W. P. Candy of the Parkesburg Iron Co. and Mr. Ickes of Worth Brothers on a modification of the flange test of wrought-iron boiler tubes, the Committee asked the representatives to prepare the needed modification for consideration at the public hearing in December.

The Committee prepared a list of invitations to the public hearing and it was suggested that the printed copies of past interpretations which had been received in proof form be made available at the hearing.

AMERICAN UNIFORM BOILER LAW SOCIETY

At one of the later sessions of the public hearing on the Code of 1914, the question of forming an organization to bring the Code before the legislatures of states and to the attention of municipalities was discussed. The Boiler Manufacturers Association had a Committee on Uniform Boiler Laws, and Thomas E. Durban, a member of that committee, realized the need of such uniformity. He had been busy from 1913 to 1916 in visiting many states and provinces to address manufacturers associations, boiler users, and state and city officials on the importance of uniformity. It was he who had brought this matter before the public hearing in December, 1914. As a result of his strenuous work the American Uniform Boiler Law Society was formed early in 1916 for the purpose of presenting the ASME Code to governing bodies of all states, provinces, and cities so as to secure, where possible, its legal adoption and to promote uniformity in boiler and pressure-vessel inspection regulations. The Society also planned to work with manufacturers and users of boilers, chambers of commerce, engineering societies, and others interested in boiler operation to secure the introduction of uniform bills using the ASME Code as the minimum requirement.

Mr. Durban became chairman of the American Uniform Boiler Law Society in 1916 with a council of twelve representatives of power-boiler manufacturers, heating-boiler manufacturers, pressure-vessel manufacturers, railroads, public utilities, and boiler equipment and appliance manufacturers. He served until 1918 when he entered government service. Charles E. Gorton, a boiler manufacturer and member of the Boiler Code Committee succeeded Mr. Durban and continued effective and strenuous work throughout the United States and Canada until his retirement in 1946, a period of 28 years. He was succeeded by William Ferguson, a former chief engineer of the Boiler Inspection Division of the Travelers Insurance Co., of Hartford, Conn.

AMERICAN UNIFORM BOILER CODE CONGRESS

To bring uniform laws before the United States as a whole, Mr. Durban planned a Congress for representatives of government and industry in Washington. Thus the American Uniform Boiler Code Congress was held in Washington, D.C., Dec. 4 and 5, 1916, under the auspices of the Industrial Commission of the State of Ohio. The report of its proceedings was issued by the American Uniform Boiler Law Society.

The governors of twenty-two states and one province of Canada, the government of the District of Columbia, and the mayors of four cities, each appointed from one to five official delegates.

The two maxims of the Congress were:

1 Civilization and government are based on human life. Its protection is government's first duty.

2 Standardization is the foreword of business efficiency.

These maxims were the controlling thoughts of the Congress and the rallying cry of the American Uniform Boiler Law Society.

Meetings of the Congress were held at the Raleigh Hotel and the first session on Dec. 4, 1916, was called to order by Hon. J. C. Callery, chief deputy, Division of Boiler Inspection, State of Ohio, chairman of the Congress. The first address on the objects of the Congress by Hon. T. T. Duffy, member of the Industrial Commission of Ohio, called attention to the work of ASME Boiler Code and the willingness of his Commission to accept it. He praised the work of the Uniform Boiler Law Society as shown by the reports of its chairman, Thomas E. Durban.

Prof. F. R. Hutton, past-president of ASME, spoke on the maxims of the Congress and pointed out their truth and the role of the engineer in defending them. At the afternoon session the Hon. P. J. McBride, Commissioner of Labor of the State of Kansas, spoke on the protection of labor as a human necessity and its effect on business economy, and Prof. L. P. Breckenridge of Yale spoke on Civil Service in the departments of boiler inspection, comparing boilers of the United States with those of Germany. He called attention to the work of preparing a Code, the need for uniformity, and the need for getting the best men for inspectors by examination.

The address by J. C. McCabe, chief inspector of the City of Detroit, was on realizations of a Uniform Boiler Code. He

cited an instance of a boiler which bore four state stamps, one city stamp, and one manufacturer's stamp. In calling attention to the inspection required in Detroit in 1888, he stated that the first inspectors were political appointees without proper qualification which, of course, had been rectified by proper laws. In discussing the conflicts between different states, he appealed for state adoption of the ASME Code.

D. M. Medcalf, chief inspector of boilers, Government of Ontario, Canada, spoke on the method used in his Province for inspection and approval of drawings which must be followed in construction. After erection the structure was checked with the approved drawing by government officials. In Canada, however, there were differences in the inspection laws of the various provinces.

During the latter part of the meeting, the subject of oxy-acetylene welding was discussed by the Congress.

Telegrams from California and Connecticut told of adoption by one state and need for uniformity in the other.

At the second day's session, December 5, Thomas C. Eipper, state industrial commissioner of New York, spoke on the preparation of a code for his state, which would meet ASME Code requirements.

Representatives from Connecticut, Louisiana, Michigan, and Missouri reported that their states were seriously considering the adoption of the ASME Code. One representative stated that his state should adopt the Code so as to escape the possibility of becoming the dumping ground for secondhand boilers.

After this, John A. Stevens spoke on the ASME Code, its formulation and aims, and Thomas E. Durban presented the following resolution:

Whereas, Industry in every line of endeavor is very closely associated with steam as a motive power and the use of steam boilers; and

Whereas, Obtainable statistics covering a period of years show that in the United States there is annually a loss of from 400 to 500 lives and the disablement of from 1000 to 2000 people due to explosions of steam boilers; and

Whereas, The Government has recognized in the effort put forth in the safety movement that its first duty is the protection and safety of human life; and

Whereas, The Federal Government, where it has jurisdiction has prescribed rules for the construction of steam boilers; therefore, be it

Resolved, that it is the sense of this Congress that all states should exercise supervision over the manufacture and use of steam boilers.

This resolution was unanimously adopted by the official delegates of various states and cities. Later in the meeting, the words "and other pressure vessels" were added at the end of the resolution.

Henry Hess, member of the ASME Council, spoke on the preparation of the ASME Boiler Code and T. J. Garney of Virginia, on boiler construction and inspection and the necessity for laws governing them.

The Hon. Edward N. Hurley, chairman of the Federal Trade Commission, spoke on standardization as the foreword of business efficiency and cited the great need for standard boiler specifications.

Helen Adelaide Goldsmith, delegate from Chicago, referred to the work of the Boiler Code Committee and that of the American Uniform Boiler Law Society.

The Congress adopted the report of the Committee on the Interchangeability of Inspectors' Certificates, and then that of the Legislative Committee which required that inspection bills contain the following points:

1 Pressure vessels be included or exempted
2 Frequency and character of inspection
3 Acceptability of inspection other than that by government
4 Appointment and authority of inspectors
5 Code of rules to govern inspection
6 Fees if any.

The following resolutions were unanimously adopted:

Resolved, That it is the sense of this Congress that the Congress recommend that all states adopt as their standard the ASME Boiler Code, thus bringing in standardization, full interchange of boilers and efficiency together to the end that the manufacturer, users and inspectors may profit by the advantages of uniformity.

Whereas, The human factor enters into the work of boiler inspection so that experience and training should be required of boiler inspectors; and

Whereas, the Federal Government in its various branches of its service has established recognized standards as to training and experience for the requirement of the various branches of federal services; therefore, be it

Resolved, That this Congress recommends to the various states where boiler inspection may in the future be provided for, that these states give full consideration to the system adopted by the Federal Government which required training and experience, tending to qualify the inspectors for their exacting duties to the end that they may devise an efficient system which gives due weight to training and experiences, that the most efficient service may be rendered to the various states where a uniform code is adopted.

THE PUBLIC HEARING, DEC. 8 AND 9, 1916

At the meeting of the ASME Boiler Code Committee on Dec. 6, 1916, with seven members present, plans were made for the public hearing to be held on December 8 and 9. During the year cases 47 to 123 had been received and discussed.

The hearing on Dec. 8, 1916, was called to order by Chairman John A. Stevens who outlined the methods of procedure, starting with the introduction and continuing through the Code to the end of the appendix. The Committee would make no final decisions at the hearing, he said, but the suggestions and criticisms would receive consideration at the revision session of the Committee. A large representation of builders, manufacturers, designers, and users were present in response to about 1500 invitations issued. Few comments were offered in connection with the material specifications, indicating that this part of the Code had received acceptance. Most of the discussion dealt with the paragraphs on boiler construction. The revised form of Par. 186 received the greatest amount of discussion as there was a growing demand for recognition of welding by other means than forging methods. The advantages of different methods of autogenous welding and a large amount of data were given by those favoring them. The heating section of the Code, as well as that relating to existing installation, received attention, and many valuable suggestions were made by representatives of state and municipal inspectors during the two-day session.

At the Committee meeting on the afternoon of Dec. 9, 1916, following the public hearing, fifteen members were present. An ASME subcommittee consisting of D. S. Jacobus, S. F. Jeter, and W. F. Kiesel, Jr., was appointed to confer with the American Society for Testing Materials. The ASTM subcommittee consisted of C. F. W. Rys, F. J. Cole, and C. D. Young.

At the Boiler Code meeting of Jan. 22, 1917, with 12 members present, the subcommittee with ASTM was continued. It was suggested by Mr. Vaughan that the Executive Committee appoint a subcommittee to formulate replies to cases in advance of Committee meetings in order to expedite decisions at the regular sessions. The subcommittee appointed consisted of Dr. Jacobus, chairman, and Messrs. Boehm, Gorton, Jeter, Kiesel, Stevens, and Obert. The subject of interpretations of the Code for the states which had adopted the Code was discussed. The advisability of appointing addi-

tional subcommittees on safety code for pressure vessels other than steam, on rules for the operation of boilers, and on recommendations distinct from the rules was proposed, but after due consideration, the appointment of such subcommittees appeared inadvisable until after the revisions of the Code had been completed. This action was reported to the Council of the Society.

The ASME Council minutes of February, 1917, record that the Compressed Air Society requested the consideration of rules to cover pressure vessels other than those for steam. The Council suggested that the Compressed Air Society submit a brief to the Boiler Code Committee covering changes or additions to the present Code with scientific facts on which to base them.

REVISION OF THE CODE OF 1914

The revision meetings of the Boiler Code Committee were held over a period of six days, beginning at 8 P.M. on January 22, with 17 members present. The Committee based its deliberations on the minutes of the hearings of December 8 and 9 and the interpretations which had been given during the previous years.

During these sessions, at the request of the Council, the Committee received John C. Parker who suggested changes in Pars. 9, 245, and 247, regarding the limitations on the use of malleable-iron header boxes. Mr. Parker presented no data to justify the changes as directed by the Council. After a thorough discussion by the Committee it was decided to appoint a subcommittee consisting of Messrs. Greene, Jeter, Kiesel, and Miller to secure evidence respecting the dependability of malleable iron in view of developments in its production since the earlier action on this subject.

At the meeting of Sept. 20, 1917, Professor Greene, chairman of the subcommittee, reported that he had consulted Prof. Enrique Touceda, consulting engineer of the American Malleable Casting Association, on the advances in the production of malleable iron since the issuance of the 1914 edition of the Code. During the previous ten years, it was reported, the quality, uniformity, strength, elastic limit, and dependability of malleable castings had been greatly improved. The principal drawback was the possible lack of care in production.

This report was finally approved by the members of the subcommittee and accepted by the Boiler Code Committee with a vote of thanks. At its meeting on Nov. 9, 1917, the Committee took no further action regarding the revision but increased the allowable working pressure with malleable-iron boxes from 160 psi to 200 psi.

The revision of Section 2 of Part 1 on Heating Boilers was not completed because of the absence of R. D. Reed, the representative of the National Boiler and Radiator Manufacturers Association.

Professor Greene was directed to prepare a table of rivet-head proportions for the consideration of the Committee, and at the last session of the six-day meeting on revisions it was decided that no actions would be disclosed until all revisions had been finally acted upon by the Committee.

Beginning with the six-day sessions of the Boiler Code Committee from Jan. 22 to 27, 1917, work on revision of the Code was continued at Committee meetings until Dec. 3, 1918, at which time the Council authorized the printing of the so-called 1918 edition of the Code. During this two-year period proposed revisions of different paragraphs were published at intervals in issues of *The Journal*, during 1917 and 1918. During 1917, the Committee also acted on cases 123 to 184, and in 1918 on cases 185 to 208. The average attendance at Committee meetings was 12 (7 to 17) members, at some of these meetings members of the Conference Committee and a number of guests invited to discuss subjects relating to revision and other pertinent matters were also present.

USE OF BESSEMER-STEEL TUBES REQUESTED

At the meeting of March 16, 1917 the Committee refused, in case 138, to grant permission for the electric-welding of superheater tubes, and considered the matter of the use of Bessemer-steel tubes in place of tubes of open-hearth steel because of war conditions as suggested by a letter of the National Tube Company. It recommended that the Council appoint a special committee to confer with the National Tube Company on this matter. The personnel of this committee was originally F. J. Cole, E. R. Fish, Andrew Fletcher, W. F. M. Goss, F. R. Hutton, Julian Kennedy, J. W. Lieb, W. M. McFarland, Spencer Miller, H. deB. Parsons, H. V. Wille, and Messrs. Durban, Jacobus, and Huston of the Boiler Code Committee. Later the personnel was changed to consist of Ira N. Hollis, Charles S. Blake, J. B. Ennis, E. R. Fish, F. R. Hutton, Julian Kennedy, Frank E. Law, J. W. Lieb, George A. Orrok, W. M. McFarland, H. deB. Parsons, James Partington, H. V. Wille, and Messrs. Durban, Jacobus, and Huston of the Boiler Code Committee.

The special committee met and considered letters from Mr. Lally of the National Tube Company to their agents and from Jos. T. Ryerson & Son. It then requested Edward Worcester, first vice-president of the National Tube Company, to meet with it to discuss the question raised by the letter of the sales manager of the company regarding Bessemer-steel tubes. The meeting was held on April 10, 1917, with H. deB. Parsons as chairman and Messrs. Blake, Wille, Hutton, Partington, Obert (for Calvin W. Rice), Stevens, Huston, Boehm, and Jacobus. Frank N. Speller of the National Tube Company represented Edward Worcester. Mr. Speller had found that Bessemer-steel tubes were brittle on beading ends and hence they used open-hearth steel. He stated that locomotive and marine work was too severe for Bessemer steel. He submitted the letter originally sent out by Clifton Wharton, Jr., manager of sales, which was quite different from the letter of Mr. Lally. He then agreed to have a new letter written approving Code requirements of open-hearth-steel tubes. When boilers were not Code boilers, customers were to be asked if Bessemer tubes could be accepted. After it had been received by the special committee the letter was reported to the Council at a meeting on April 23, 1917. The Council (item 1281) approved the letter and its publication and thanked the special committee at a meeting on May 21.

Even earlier, on Jan. 19, 1917, the Council directed the Boiler Code Committee to send a letter to R. L. Heminway, safety engineer of the Industrial Accident Commission of California, stating that they could not grant relief from the code requirements of firebox steel, even though this steel was difficult to secure on the Pacific Coast because of war conditions.

APPOINTMENT OF SUBCOMMITTEE ON WELDING

The matter of autogenous welding was being brought before the Boiler Code Committee by many builders and was referred to a subcommittee (Subcommittee on Welding) of which F. L. Fairbanks was chairman. Many requests were made, but as no standard rules had been formulated, the requests were always answered in one way, and autogenous welding was only allowed where no strains were placed on the weld.

At the meeting of Sept. 20, 1917, the Boiler Code Committee heard Llewellyn Williams of the American Society of Refrigerating Engineers and C. H. Bryce of the National Acetylene Association in presentations of the state of welding specifications. The autogenous welders were also heard, but the statements proved to be of little value because the different interests were in conflict and could agree on nothing. The Committee

pointed out that when there should be agreement among all welding interests, they could then present their recommendations to the American Society of Refrigerating Engineers and the Boiler Code Committee. The Committee desired such recommendations and stood ready to co-operate, but the experience at the hearing made it clear that the welding interests should come to agreement on as many points as possible if these new methods of fabrication were to advance.

The National Welding Council, which had been formed during World War I, invited the Society to become affiliated with it in an investigation and standardization of welding procedure; and on March 4, 1918, Calvin W. Rice, secretary of ASME, suggested the personnel of a subcommittee of the Boiler Code Committee as follows: F. L. Fairbanks, *Chairman;* F. J. Cole, Locomotive Committee(sub); J. A. Dixon, pressure tanks; E. R. Fish, Boiler Code Committee; S. F. Jeter, Boiler Code Committee; M. W. Kellogg, power-plant piping and receivers; Wm. F. Kiesel, Boiler Code Committee; and Henry Torrance, American Society of Refrigerating Engineers.

To this subcommittee S. W. Miller was added on Dec. 2, 1918.

LOW-PRESSURE HEATING BOILER CODE

A subcommittee to work with the American Society of Heating and Ventilating Engineers was suggested at the Boiler Code Committee meeting (item 436) on Oct. 25, 1918, for the purpose of revising the heating-boiler section of the Code.

During September, 1917, C. W. Obert, secretary of the Committee, was invited to address the National Association of Stationary Engineers on their relation to the application of the Code. After this, at the request of Thomas E. Durban of the American Uniform Boiler Law Society, Mr. Obert visited several states and municipalities which had adopted the Code to speak on the Code and meet with those who were administering it. He made a complete report to the Committee of his experiences and the suggestions that had been made for the improvement of the Code.

On Oct. 12, 1917, the Council appointed a subcommittee on Feedwater Heater Standardization.

During the revision period, the subcommittee to confer with the American Society for Testing Materials was C. D. Young, chairman, F. J. Cole, and C. F. W. Rys for the ASTM and D. S. Jacobus, chairman, S. F. Jeter, and W. F. Kiesel, Jr., for the Boiler Code Committee, with J. T. Wallis, general superintendent of motive power, P.R.R., T. E. Durban, American boiler manufacturer, National Tubular Boiler Manufacturers and National Association of Tractor and Thresher Manufacturers, Isaac Harter, Jr., Babcock & Wilcox Co., and John A. Stevens, Boiler Code Committee. This group, with representatives of the Association of American Steel Manufacturers and the American Tube Manufacturers, were active in preparing the way in which material specifications and the table of tube sizes should appear in the new edition of the Code.

MINIATURE BOILER CODE

Case 140 considered at the Boiler Code Committee meeting of Nov. 16, 1917, referred to revision of Par. 266 on washout holes to cover small vertical boilers made of pipe. This was one of the first cases which indicated the need for a code for miniature boilers, as such boilers were being manufactured in quantities for various services.

RULES FOR INSPECTION

At the Council meeting of Dec. 7, 1917, E. R. Fish was appointed to the Boiler Code Committee to fill the vacancy caused by the death of Col. E. D. Meier, and Fred R. Low to fill that caused by the death of H. S. Stott. W. H. Boehm was appointed as the representative of the Boiler Code Committee on the National Welding Council.

At the Boiler Code Committee meeting of Jan. 3, 1918, E. R. Fish was delegated to appear before the Board of Supervising Inspectors of the Steam Boat Inspection Service, to ascertain whether they advised any changes in the revisions of the Code.

At the Council meeting of May 17, 1918, Dr. Jacobus reported that the Boiler Code Committee had received requests from various sources to prepare rules for inspection of boilers, that it had considered such rules desirable, and that it suggested a subcommittee for this purpose. The Council approved this recommendation and referred it to the Committee with power.

The Boiler Code Committee appointed the following subcommittee: Charles S. Blake, Hartford Steam Boiler Inspection and Insurance Co., *Chairman;* Charles E. Gorton, Gorton & Ledgerwood; F. H. Herendeen, National Boiler & Radiator Manufacturers Association; James Partington, American Locomotive Co.; and John L. Thompson, Travellers Insurance Co.

During the latter part of 1918, the Boiler Code Committee was unable to receive data from the National Boiler & Radiator Manufacturers Association in connection with the section of the Code relating to heating boilers. At the meeting of December 2, F. H. Herendeen and Prof. H. L. Pryor, their consultant, appeared before the Committee to clear up some desired changes in this section of the Code, but on those on which agreement was impossible, the Committee adopted its own formulation with the understanding that such would be interpreted as Cases under the new edition of the Code.

No data were submitted on the strength of cast-iron boilers, and a subcommittee consisting of J. C. McCabe, Prof. J. R. Allen of the University of Michigan, and M. E. C. Fisher of the Boiler Code Committee was appointed to collect such data. The safety-valve manufacturers had submitted no criticisms or suggestions for the paragraphs dealing with safety valves and their use which had been sent them. These also might require interpretations.

As the revisions had been completed and published in *The Journal*, the Council authorized the Boiler Code Committee to proceed with the publication of the 1918 edition of the Boiler Code as presented to it by the chairman, John A. Stevens at the meeting of Dec. 3, 1918 (item 1647).

In the four-year interval between the 1914 and the 1918 editions of the ASME Boiler Code, reviewed in this chapter, the Boiler Code Committee succeeded in developing the procedures whereby "interpretations" and "revisions" of the Code were formulated, approved, and published. In this same period the Conference Committee was set up and the practice of appointing subcommittees of experts to deal with special phases of the Committee's work was established. In spite of pressures brought to bear on the Committee by several groups and interests, the Committee held steadfastly to a high and unbiased concept of its function as trustee of the public welfare and established confidence in its integrity and achievements.

Although a chronological treatment of the events of the four-year period may appear to be confusing, it was adopted as the best means of portraying the conditions under which the Committee undertook its task and developed the procedures by which that task was accomplished. It emphasizes the fact that the problems which confronted the Committee, some of which were highly controversial, appeared in no logical sequence.

In Chapter 4 of this history, which covers the interval between the 1918 and 1924 editions of the Code, certain specific developments, notably that of autogenous welding, are described.

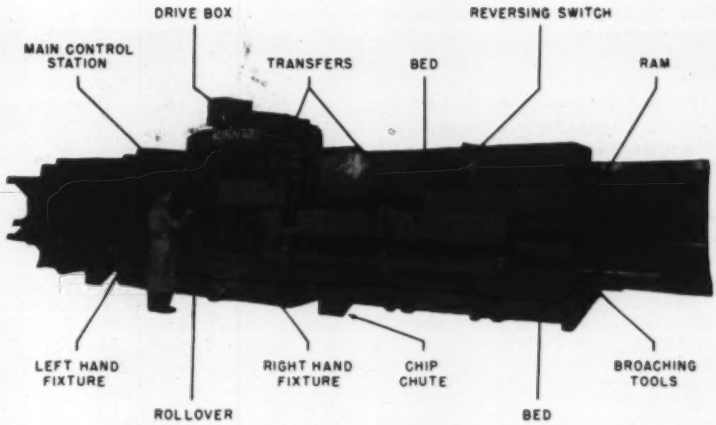

FIG. 1 HORIZONTAL TWO-WAY BROACHING MACHINE FOR CYLINDER HEADS

High-Speed SURFACE-BROACHING MACHINE

By E. C. RAEHRS and E. J. RIVOIRA[1]

THE CINCINNATI MILLING MACHINE COMPANY, CINCINNATI, OHIO

INTRODUCTION

IN today's dual economy, the ever-increasing need is for more production at lower cost. Executives of metalworking plants have been intensifying their search for new and improved ways to increase productivity, and have found that broaching offers a number of distinct advantages over more conventional machining methods. The result has been and will continue to be a wider application of broaching wherever conditions are favorable.

The rapid rise of the process has resulted from (1) the ability of broaching to remove metal faster than any other comparable method, and (2) its ability to produce machined surfaces to a high precision and finish. Its application usually is limited to surfaces parallel with the axis of the cutting tool, which have no obstructions in the plane of the broached surface, and where the part is strong enough to withstand the required broaching thrust or can be supported adequately.

In 1934 a special horizontal broaching machine was developed by our company to perform various operations. This machine was operated hydraulically, utilizing five hydraulic pumps, each driven by a 30-hp motor. The cutting speed was 37 fpm with a resultant production of 55 to 60 parts per hr. A set of cutting tools for one of these machines cost the customer approximately $5000. That was a lot of money for tools in those days, especially when it was considered fortunate for the operator to be able to run them for 5 days between tool changes. Also, foundries were unable to hold a specified amount of stock removal and maintain material of good cutting qualities. This resulted in much tool breakage and discouraged customers.

In spite of some discouragement in the early days, continued progress has been made until today broaching is considered one of the important methods of machining. Progressive developments have resulted in a machine capable of using tungsten-carbide cutting tools for cast-iron operations, utilizing cutting speeds up to 200 fpm, in comparison to the former 37 fpm. Production obtained from these machines is over 150 pieces per hr on some large parts requiring only one operator, who keeps two men busy loading and unloading. Tool life has increased from approximately 4000 pieces per grind to 50,000 pieces per grind, and in one case as high as 150,000 pieces before sharpening was necessary.

Fig. 1 shows a horizontal two-way broach, machining an automotive cylinder head. This machine, weighing approximately 90 tons, is capable of developing a peak of 600 hp. It occupies a floor space of approximately 19 ft. × 51 ft, a tremendous saving in space over previous methods of obtaining this production. When shipped, it was a full-capacity load for a 45-ft flatcar.

The function of this machine is to remove rapidly a large amount of metal, from a securely held rough forging or casting, to an accurate surface finish in one pass of successive broaching tools.

DESIGN OF BROACHING MACHINE

The first procedure in the design was to outline the requirements and review the past performance. Some of the factors considered were as follows:

[1] Jun. ASME.

Contributed by the Machine Design Division and presented at the Semi-Annual Meeting, Cincinnati, Ohio, June 15-19, 1952, of The American Society of Mechanical Engineers.

Power requirements based on maximum amount of stock removed and maximum cutting speed.

Fixture and tool requirements.

Material handling.

The basic design was blocked out to determine the following:

Principles of operation and the relation of various units.

Type of drive to meet the requirements.

Principles of the work-holding and method of work movement.

The next step was to complete the layout of each unit in terms of sound engineering principles, keeping in mind the large forces developed. Since this is a key machine in line production, its down time represents large losses so the design was reviewed carefully for safety and ease of maintenance and service.

The machine shown in Fig. 1 consists of the following units: The bed; reciprocating ram to carry the cutting tools past the work; driving mechanism for reciprocating the ram; work-holding fixture; transfer mechanism and rollover; frame and support for the elements; tools; power plant.

The All-Steel Bed. The bed supports all of the elements and must handle all of the reactive forces. It is of all-welded construction approximately 6 ft wide, 7 ft high, and 36 ft long. The complete structure is reinforced to form uniform compartments using steel plates and box sections. The total weight of the bed unit is approximately 50,000 lb, and it is stress-relieved thoroughly.

The great rigidity of this large structure and its resistance to bowing and separating forces are important features of the high cutting ability of this machine. The bed supports the ram ways. These ways, shown in Fig. 2, are constructed of $6^1/_2$-in. × 9-in. rectangular hollow high-grade cast-iron sections, hardened and surface-ground to within 0.0002 in. on the thickness dimensions. They are bolted to planed surfaces producing a perfectly aligned way. The uniform hollow sections reduce warpage to a minimum in heat-treatment.

Reciprocating Ram. The reciprocating ram shown in Fig. 3 carries the cutting tools and is of modified box construction. It consists of 3-in. plate 43 in. wide, 24 ft long and of three 2-in. × 12-in. members running the full length of the ram. The complete unit weighs 12,000 lb, and is stress-relieved.

The driving rack is fastened to the back of the ram and travels at a maximum speed of 200 fpm for a stroke of 18 ft.

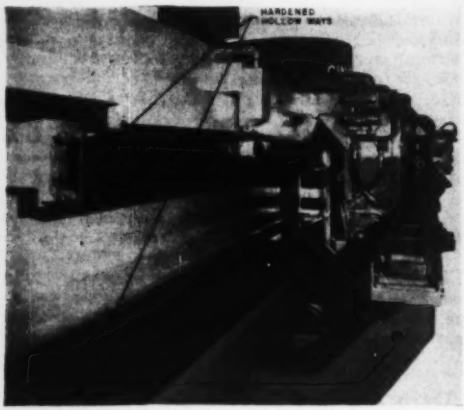

FIG. 2 HARDENED HOLLOW WAYS WHICH SUPPORT THE RAM

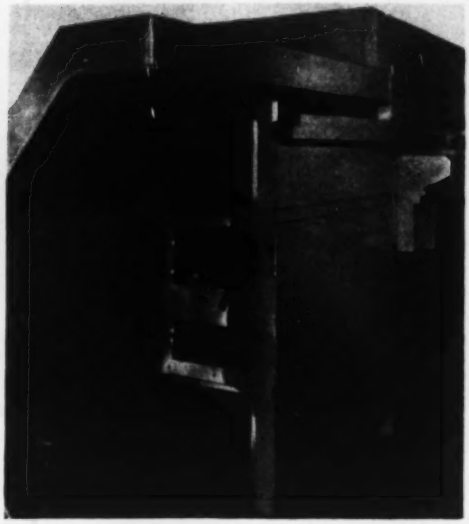

FIG. 3 END VIEW SHOWING BOX CONSTRUCTION OF RAM

This unit has more than 5000 sq in. of bearing surface to support the high cutting loads. The high-grade cast-iron ways are planed in position.

Driving Mechanism for Ram. The ram is driven by an adjustable-speed d-c motor directly coupled through a worm and wheel to a rack and pinion. This unit through the 20-to-1 worm reduction gearing is capable of handling peak loads of 600 hp.

The driving worm with a diameter of 13 in., drives a 49-in. worm wheel, mounted on a shaft $10^3/_4$ in. diameter at the center. Tapered roller bearings with outside diameters of $16^1/_2$ in. carry the thrust, while roller bearings support each side of the taper-mounted 15-in. face pinion and the outer end of the worm wheel.

The entire unit is constructed so as to permit the pinion, cartridge-mounted supporting bearings, and taper-mounted worm wheel to be assembled as a subunit and lowered vertically by crane into the heavily ribbed cast main housing. Likewise, the entire worm unit, including housing and bearings, is assembled as an individual component and swung horizontally by crane into meshing position with the worm wheel. The entire drive unit is then lowered into working position in the frame. A tapered eccentric ring located at the lower end of the unit housing is jacked up to lock the driving unit positively in the aligned position.

Worm and wheel lubrication is accomplished by multiple-pressure jets directing streams of oil to the proper contact areas. Surplus oil is drained back to the tank and pump unit for filtering and recirculating.

This unit is designed to be used for vertical or horizontal applications.

Work-Holding Fixture. Fig. 4 shows the right-hand work-holding fixture in loading position and the left-hand fixture in cutting position.

Because of the large amount of metal removed per minute, the forces to be absorbed by the fixture are of much greater magnitude than the forces encountered in other fixture designs.

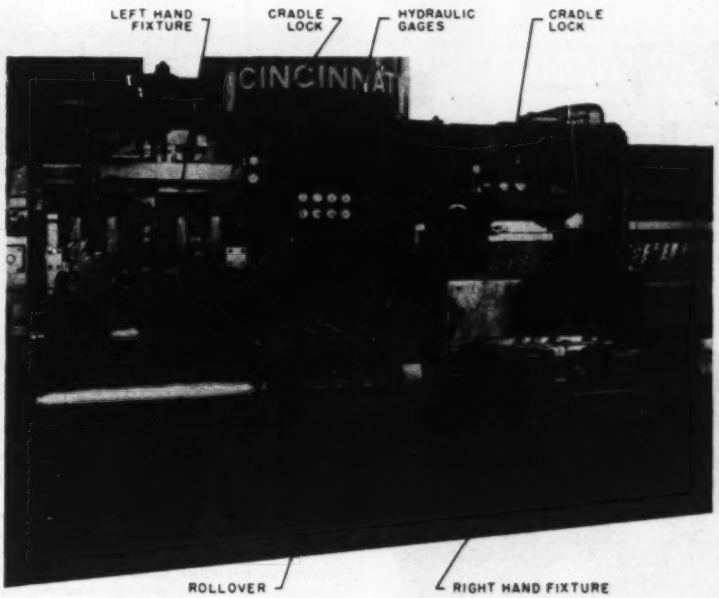

FIG. 4 RIGHT-HAND FIXTURE IN LOADING POSITION, LEFT-HAND FIXTURE LOCKED IN CUTTING POSITION

Approximately 7 lb of stock is removed from a typical V-8 engine head during each cycle.

The fixture must be massive to hold the part firmly and to obtain the necessary rigidity and freedom from vibration. The major forces exerted by the cutting tool are in two directions, one parallel to the direction of the ram movement, and the other at 90 deg to this.

As shown in Fig. 4, the locating and supporting pads are massive to handle the stresses set up by the broaching forces, and are located as close to the cutting surface as practicable.

The part is clamped mechanically by spring-loaded irreversible plungers with locking angles, and it is unclamped by hydraulic cylinders.

When the fixture is indexed into position, the lock bar is lowered over the clamping pads to tie the fixture into the upper machine structure thereby resisting the separating forces as shown in the left-hand fixture, Fig. 4. The forces parallel to the ram movement are taken by fixed stops located in the machine frame. The fixture is cammed into position and moved against these stops by heavy springs.

Workpiece Transfer Mechanism and Rollover. The transfer mechanism, built in two sections, is hydraulically operated. The movement of the transfer mechanism is parallel to the ram in a right to left direction transferring the part from the right-hand fixture to the rollover and moving the new part into the right-hand fixture.

The rollover receives the part completed by the right-hand fixture, turns it 180 deg during the fixture index, and stores the part until the next cycle. Since the machine cuts in both directions, the tools are at two different levels—therefore the work in being turned must be deposited at a higher level.

In the next stroke the part in the left-hand fixture is transferred to the outgoing conveyer and the part from the rollover is transferred to the left-hand fixture.

Fixture and Rollover Frame. The fixture frame supports and ties the fixtures, rollover, transfer, and so on, into the bed. The frame is of welded construction consisting of four 3-in. and one 2-in. vertical members, horizontally tied together with 1-in. members. The completed unit weighs approximately 15,000 lb, and is stress-relieved. It is bolted to the main structure through $1^1/_2$-in. plates.

The Broaching Tools. Tungsten-carbide inserts are used in most tools for these machines. These tools, or bits, must be strong enough to withstand the cutting force and spaced to allow the chips to be carried away freely.

Fig. 5 shows how each bit is held so it can be adjusted or replaced in a very short time. The tools are held in a broach holder made of sections approximately 40-in. long bolted to the ram and located by a key.

When sharpened, the height of each tooth is set to a gage by turning adjusting screw A and adjustment locked by nut B. The tool is then locked in position by clamp C.

The outstanding feature of these tools is their uniformity. Gang-type fixtures for the sharpening operation can be made to accommodate all bits of any given size. Bits can be purchased and stocked in smaller quantity, thus reducing cost of maintenance and storage expense.

Chip progression, or "chip per tooth" is built into the holder by means of a step bar ground to the proper height and used as a backing plate to resist cut pressure. The amount of step or graduation is determined by the amount of stock to be removed, and the length and width of workpieces. The stock removal per tool on the roughing operation is usually 0.015 in. to get under the scale, reducing to 0.005 to 0.008 in. for the completion

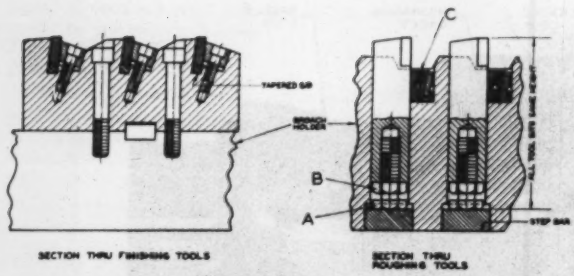

FIG. 5 CROSS SECTION THROUGH ROUGHING AND FINISHING TOOLS MOUNTED ON HOLDER

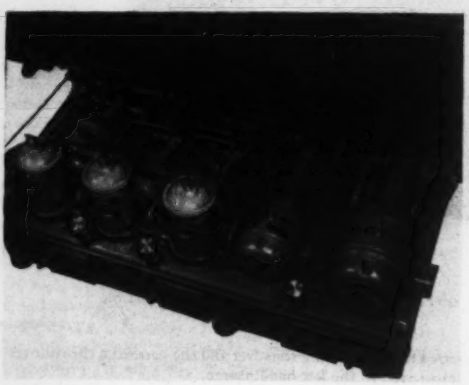

FIG. 6 CENTRAL HYDRAULIC TANK WITH MOTORS AND PUMPS

of the roughing operation. The finishing tools are full-width tungsten-carbide blades as shown at the right in Fig. 1, and set to remove 0.002 in. per blade at the start and 0.001 in. at completion. Each of these tools is adjusted independently by a tapered gib as shown in Fig. 5. The tools are always in view of the operator so that broken tools can be spotted and easily replaced.

The chips fall from the tools and away from the fixture into channels. Wipers attached to the ram push the chips to convenient discharge points.

Operating Power Plant. Hydraulic power and lubrication are supplied from a central source, shown in Fig. 6. Mounted on the tank are the motors, pumps, and related equipment to supply lubricating oil to rams, ways, worm, and wheel. This unit also supplies hydraulic oil for raising and lowering the fixture, for clamping the work, and for the transfer and rollover operation.

The original hydraulically driven machine using five motors was changed later to use eight 30-hp motors driving the hydraulic pumps. The result is a machine capable of a speed of 60 fpm. This proved that it would be impractical to use such a drive for a machine which would have the power and speed capable of taking full advantage of the cutting speed of tungsten-carbide tools which on cast iron, is approximately 250 fpm.

The drive selected had to have fast acceleration and deceleration, repetitive accuracy of stopping, possibility for speed adjustment, smooth acceleration to eliminate shock load and high pull-out torque. The adjustable voltage drive was selected as the type best fulfilling these requirements.

The motor is directly connected to the worm drive and its power supply is from a remotely mounted generator driven by a 300-hp totally enclosed fan-cooled ball-bearing a-c motor. The drive handles peak loads of 600 hp, without appreciable change in speed. It accelerates to full speed in $1^1/_2$ to 2 revolutions and decelerates in the same time.

A solid loop connection is used between motor and generator. The complete control of the motor is through seven relays operating in the motor and generator fields, thus permitting fast operation and selective optimum speed in either direction.

Speed data were taken by oscillograms and power at various positions of cut with a recording meter directly rotated by the movement of the ram.

DESIGNED SAFE OPERATION

Safety was given the highest priority in this design. It is hardly necessary to review the sequence interlocking arrangements, but a few of the different safeties designed into the machine may prove interesting.

The fixture-locating pads are designed to permit the passage of a fixed amount of air. When the orifices are blocked by the part being located properly the pressure increases, operating a pressure switch which permits the next function. This system eliminates all of the troubles resulting from dirt, sticking plungers, and the like, and locates the casting within 0.002 in.

An ammeter at the operator's station constantly indicates the cutting load. When this load increases beyond normal, it is an indication to the operator that the stock is heavy, the material is hard, or the tools are dull. Should the load exceed the capacity of the drive or a wreck occur, authorized personnel, after determining the conditions, will operate a jog button which is normally locked, to move the ram at very low speed and momentary high torque.

Stopping of the ram is through heavy-duty limit switches operated by dogs carried on the ram. Should the electric circuit fail or the dogs move, the rack is designed to run off of the pinion. To dissipate the inertia of the ram, a soft-steel plate is bolted to it and located to travel past cutting tools fixed in the bed. These cutting tools removing approximately $^1/_8$ in. of metal readily dissipate the energy and bring the ram to a stop. When the cause has been remedied, the ram is easily brought back into mesh with the pinion.

HOW THE MACHINE OPERATES

Complete individual unit operation is provided through the push-button control shown in Fig. 7. An automatic cycle is as follows:

1 Right-hand fixture down, work unclamped, work moves from right-hand fixture to rollover and at the same time new part is moved from conveyer into right-hand fixture by transfer bar.

2 Operator shifts lever on right-hand fixture, clamping work.

3 Operator presses "preset" and "cycle start" buttons.

4 Left-hand cradle lock raises.

5 Right-hand fixture swings into cutting position and left-hand fixture moves into unloading position.

6 During down movement, work unclamps in left-hand fixture.

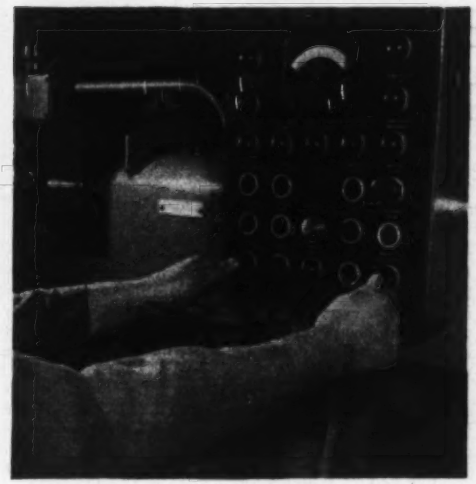

FIG. 7 MASTER-CONTROL STATION

7 Right-hand cradle lock swings into locking position.

8 Ram starts cutting to the left.

9 Left-hand transfer moves to left and moves work out of fixture onto outgoing conveyer and part from rollover is transferred into fixture. Transfer returns to starting position.

10 When ram reaches left end of stroke, it stops, completing one-half cycle.

11 Operator shifts lever on left-hand fixture clamping work.

12 Operator presses preset and cycle start buttons.

13 Right-hand cradle lock raises.

14 Left-hand fixture swings into cutting position and right-hand fixture moves into unload-position.

15 During down movement work unclamps in right-hand fixture.

16 Left-hand cradle lock swings into locking position.

17 Ram starts cutting to right.

18 Unload and load right-hand fixture.

19 At end of stroke, ram stops, completing full cycle.

Should operator complete the loading and clamping of a part and operate the preset and cycle start buttons, the circuit holds until the ram stroke is complete and then automatically starts the next cycle.

This cycle is completed in the following time:

	Minutes
Index right-hand fixture	0.080
Broach 18 ft at an average of 180 fpm	0.100
Index left-hand fixture	0.080
Broach 18 ft at an average of 180 fpm	0.100
Total time per cycle	0.360

CONCLUSION

Our tests show that the cutting time can be reduced further. However, this will not affect the over-all cycle time appreciably. How to reduce the material-handling time is the problem confronting the engineer.

As we have mentioned several times, extensive use of fabrication was made in this machine. Experience shows that great economies can be realized by this method in small-lot production. Usually we make use of fabricating methods in highly specialized machines. Occasionally when production quantities reach a certain volume the machine is redesigned to use cast members instead of fabricated units.

This machine is moderate in weight for its size owing to the excellent strength-to-weight ratio of steel. By close co-operation between engineering and the welding shop, we have been able to reduce weight by judicious location of ribs and plates to obtain maximum strength and stability.

The machine was built economically because it progressed through production without great difficulties arising from unforeseen complications. The design was so sound that no significant changes were made before manufacturing a large number of these machines.

The Italian Power Industry

(*Continued from page 722*)

prospecting for and utilization of oil and gas reserves in Italy should be open to all organizations capable of undertaking such activity, on the basis of clear and practical legislation that must combine the interests of the general public and these organizations. This is what has been done in Italy for the exploitation of hydroelectric resources, which was undertaken jointly by different types of enterprises, within the framework of wise legislation covering public waters and electric installations.

We are convinced that in the power sector the experiment was an unqualified success. Even those who are most stubbornly biased against the private power companies in Italy have had to admit that our industry has been developed under a system of free enterprise as well as anybody could wish. It would be highly desirable that the same should apply to natural gas.

RATES

There remains to be mentioned the sorest problem for our industry today—rates.

All the work of the past few years that I have described, all the plans for future expansion, cannot be given their full significance unless one bears in mind the continuing enforcement of a rate control under which we have had to operate since 1936.

At present, rates are 24 times the prewar level, while the general price index is 60 to 70 times, and for electrical installations at least 80 times. Notwithstanding the fact that the power companies, upon request of the authorities, proved the necessity of further increases through the most detailed accounting and the opening of their books, nothing, as yet, has been done.

The rate freeze seriously affects the economic operation of the utilities. Among other effects, it prevents a normal rate of maintenance and depreciation of the installations and brings about insufficient returns on capital, thereby affecting the possibility of raising funds which the power companies badly need for future developments, and discouraging investments into the most important activity for the economic development of the country.

The power industry, therefore, quite aware that its duty is to meet future power requirements, can only hope that the present political situation, which so seriously affects its activity, will soon improve. And it is with this hope, based on simple principles of fairness, that we are continuing to operate. We know that in so doing we are not only defending individual interests. Far beyond these interests, we, who have devoted our whole life to the power industry, see in it both the proof of the building capacity of private enterprise and one of the foremost contributions to progress.

PUBLIC RELATIONS *and* ENGINEERS

By EUGENE A. ROSE

PUBLIC RELATIONS COUNSELOR, FRED SMITH AND CO., INC., NEW YORK, N. Y.

IN the field of public relations, you engineers are a paradox. You are among the American public's heroes—in the same rank as baseball players and airplane pilots. You stand far above businessmen, and an infinite distance above politicians. Take any current novel or play. A character who is an engineer invariably turns out to be virile and handsome, and gets the heroine. The businessman, in contrast, is likely to be a sinister person, and the politician a scoundrel. The public has the utmost confidence in you engineers, and your abilities and wisdom. If anything is wrong anywhere in the world, it believes you engineers can fix it.

In spite of all this, my engineering friends tell me they find their public relations difficult. Those who are with large corporations have difficulties with the corporations' officers and boards of directors. They find it hard to make the officers and directors understand the nature and importance of what they are doing, especially in the case of research appropriations and new techniques and products.

I am told, too, of difficulties with the general public; and, in an increasing degree, you engineers are being obliged to deal with the public. The postwar construction of natural-gas distribution systems has, I gather, been an immense problem in public relations. Again and again, trunk lines have been delayed while the engineers in charge have wrestled with local sentiment, or—if you prefer—local greed, and in some cases, the course of the trunk lines has had to be changed. These delays and changes have meant heavy additional costs.

A short time ago, the head of my own public-relations firm spent an evening with a brilliant chemist, a man in charge of an important atomic research project. The chemist spent four hours telling my colleague why he didn't understand public relations, and never expected to. The burden of what he said was that in chemistry everything was capable of exact measurement and exact prediction. When he said something in the field of chemistry it was true. If anyone doubted him, he could take that person into his laboratory and prove it was true. In science, things could be said without qualifications; science had no "ands," "ifs" or "buts." But in the field of public relations, the chemist could find nothing either measurable or predictable. At the end of the evening, he summed up his feeling by saying public relations were witchcraft, pure witchcraft.

I can sympathize with the chemist although I feel bound to say that he was not being entirely accurate or fair. We have public-opinion polls, consumer surveys, and similar efforts to measure public attitudes. And you may have heard of the remarkable experiments being made at Yale into the mechanism of credibility—why people will believe a statement when it is phrased in one set of words, and will refuse to believe it when it is phrased in another set. Many other universities are carrying on related investigations.

In spite of these beginnings, the chemist is probably nine-tenths right. You engineers can appreciate even better than I that true laboratory conditions can never exist with human beings. The molecule of iron or hydrogen that you deal with is exactly like every other molecule. The social scientist has to deal with human beings as he finds them, and every human being is different, and different in mysterious and unfathomable ways.

Public relations is an art, not a science. The atomic-research chemist is mistaken, however, in calling it a black art. There is nothing especially occult about it. It is a matter of experience, common sense, and intuition.

You engineers have one special difficulty that most other people don't have. One of the main things in public relations is getting the other fellow to understand us—in being able to communicate with him. If we can get the other fellow to understand what we are doing, and our plans and hopes, half the battle is won. Here you engineers are at a disadvantage. It is not merely that you have professional jargons that are unintelligible to the man in the street. It is much more that you have a different kind of mind—the scientific mind that proceeds by hypothesis, experiment, and verification. The mind of the general public works the other way round; it begins by deciding whether it likes the end result, and then works backward.

I have often thought Professor Einstein is the most-approved and least-valued person alive. He is approved because all scientists are approved, and, since he is thought to be one of the greatest scientists in all history, he is especially approved.

But ask the next person you meet about Einstein's curved space. I'll make you a bet that his first words will be to ask why anyone should care whether space is curved or not. Unless you can answer his question—and I am frank to say I can't—he will take no further interest in the Einsteinian theories.

You engineers have to realize that there is an immense gulf between yourselves with your scientific cast of mind, and the general public with its cheerfully unscientific mind. This gulf, however, can be bridged. Let me illustrate how I think it can be bridged by a job that my firm has just done.

One of our clients is a corporation making automobile tires and many products growing out of rubber chemistry. From being a small company, it has become an industry leader. Its research staff is now unrivaled. A proof of this is that foreign rubber manufacturers, wishing to have research done, pay this company three to four times what they would have to pay its American competitors.

Our clients' research men hit on a new way of making synthetic rubber. They believe their discovery is of a revolutionary character. It makes possible a rubber that, in many respects, is superior to natural rubber. Its cost is less than other synthetic rubbers. It opens up new uses for rubber through the whole of American industry.

As you may know, the production of rubber is now under the various defense agencies. Without the approval of Washington officials, it was impossible, as a practical matter, for our

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client to go ahead with its new process. Approval of the process, however, would have meant that Washington would have had to recast its rubber program.

Understandably, Washington had resistance to believing that our client's process was as revolutionary and important as, in fact, it was. But the big problem was to get officials—men who were administrators or lawyers—to sit down and study the matter. What our client wished to tell them was what its research men's discovery would do for industry and the country, in the cold-war emergency. What the officials wished to know—and all they wished to do—was what bureaucratic regulations our client wished rescinded or promulgated. Our client had a great story to tell, but it found it couldn't communicate with its public—in this case, the Washington officials.

The device we finally adopted was to set out the whole story of our client's growth as a corporation from its start, back in 1915, up to the present day. As much as possible of the story was told in transparencies—photographs in color with lights behind them—and in three-dimensional representations in wood and paint, glass and colored liquids, relief maps. We had a motion picture that ran when anyone pushed a button, and a very large assortment of our client's actual products. All these exhibits were arranged in an orderly way and installed in one of the banquet rooms of a Washington hotel. Giant wooden arrows suspended from the ceiling showed how each of our client's activities had grown from earlier ones. To any Washington official entering the exhibit, it said: This is a growing American corporation, and somebody you ought to take time to know about and listen to.

Perhaps some of you engineers won't think much of what we did. You will say that you wouldn't make up your own minds about a corporation by looking at transparencies, and still less whether it had developed an important new industrial process. You will say you would rather have professionally competent engineering papers, complete with graphs and tables of figures.

If you say that, however, you will be wrong. What you will be saying, in effect, is that no one has a right not to be an engineer, and have an engineer's mind. You will be telling how you would like to be communicated with, instead of thinking how the other fellow—here the Washington official—wishes to be communicated with. And right here is the most important witchcraft that we public-relations people exercise. We try to put ourselves in the other fellow's place.

What is the Washington official's side of the case? In a seven-and-a-half-hour day, there are 450 minutes. Officials in the defense agencies have many claimants to those 450 minutes. They have an urgent self-interest in brevity, and we made it our business to be brief. The officials were without engineering education; maybe they should have had it, but they didn't. It was our business to talk in layman's language, so we did talk in layman's language. The officials—like everyone—preferred to know with whom they were dealing. It was our business to make them feel they knew our client intimately, its growth and struggles and successes, and we tried to do just that. And, finally, the officials—again like everybody—wanted to feel that they were drawing their own judgments and were not having a conclusion forced down their throats. It was our business not to force a conclusion on them, and we didn't.

What this illustration will mean to you, I hope, is that public relations, if it is witchcraft, is only the witchcraft of common sense, sincerity, and friendliness. As you engineers come to have more and more responsibility for the conduct of industry, you will need to give increasing attention to public relations. I hope that none of you, like the atomic-research chemist, will throw up his hands in despair. I hope you will say to yourselves: How can I make this other fellow listen to me? I assure you that the efficiency of American industry will be greatly increased if you do, and that America as a whole will reap the benefit. But sometimes this problem of communication becomes very difficult and cannot be solved without the large expenditure of time on your part. In such cases, I hope you will not hesitate to call in professionals at public relations. As I said at the beginning, you will find their techniques different from yours, but the field they operate in, although unlike the field of engineering, is an important one.

In a broader sense, this field of public relations comprehends how we Americans get on together as a community—the kind of nation we have now and shall hand on to those who come after us. This last task, the building of understanding between generations, is the last and highest one.

Choosing New Machinery and Equipment

(Continued from page 720)

facts developed in the larger work, "Dynamic Equipment Policy." This manual in no sense is a replacement of the larger textbook, but it does provide the essential material so as to understand the formula. Other references are given at the end of the paper.

CONCLUSION

An intelligent replacement equipment program, staffed with proper people and properly worked out as to methods, will give management outstanding dollar facts about excess costs. The same procedure can be applied to studying methods and processes, as well as an analysis of material or parts purchased from outside sources. Management can set up a realistic and forward-looking program to maintain its shop equipment at optimum efficiency, reinvest the stockholders' dollar to obtain the maximum profit, and above all, a periodic review will show specifically what it is costing a company not to make the indicated replacements.

REFERENCES

"Computing Return on Invested Capital," National Machine Tool Builders' Association, Cleveland, Ohio.

"The World's Best Investment," National Machine Tool Builders' Association, Cleveland, Ohio.

"How to Figure Cost Savings on Machine Tools," by Athel F. Denham, Denham & Company, Detroit, Mich.

"Practical Application of the MAPI Replacement Formula," by Everett M. Hicks, Norton Company, Worcester, Mass.

"Company Procedural Manual on Equipment Analysis," by W. Kelly & Company, Chicago, Ill.

HOW hot or cold it is from 55 to 75 miles above the earth may be determined by the Army Signal Corps through a new method for gathering facts about the weather.

The new method employs an inflated sphere released after an 80-mile ride into space in an Aerobee rocket.

The sphere, which looks like a partially deflated balloon, is carried in a wooden cylinder just behind the nose cone of the rocket. Near the peak of the rocket flight, the 14½-ft nylon sphere is released. Air from a pressurized cylinder finishes blowing up the sphere and gives it shape.

Enclosed in the nylon sphere is an electronic transmitter capable of sending continuous signals to a ground station where the data is recorded. Temperatures in the upper-air atmosphere can be determined by measuring the rate of fall of the sphere. The sphere is neoprene-impregnated, and 1/50 in. thick.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Military Production

REVOLUTIONARY technological advances growing out of World War II—in atomic energy, jet propulsion, electronics, the use of light metals, the shaping of these metals with heavy presses, and other developments—are still having a massive impact on military science and military production, according to the Sixth Quarterly Report to the President, dated July 1, 1952, by John R. Steelman, Director of Defense Mobilization. The rapidity of development in these fields is at the heart of many problems of producing truly modern weapons.

Entitled, "Defense Mobilization—The Shield Against Aggression," the report points out that we are building toward the new and higher goals set by the President last January—a 143 wing Air Force, an Army of 21 full-strength divisions, a Navy of over 400 combat ships and 16 large carrier air groups, and a Marine Corps of three divisions and three air wings.

A review of the various categories of the military procurement program indicates the extent of progress and the momentum that has now been achieved.

Aircraft

Deliveries of military aircraft, now over 800 a month, are more than three times the rate of two years ago, figured either in number of planes or in airframe weight.

The monthly rate of deliveries in terms of numbers of aircraft is now about two thirds of the peak delivery rate scheduled to be reached in mid-1953. Measured in airframe weight, production is about one half of the scheduled peak, which will not be reached until the second quarter of 1954. Production when measured in numbers of aircraft is closer to peak rate than when measured in airframe weight because the proportion of fighter and other light types to bombers and heavy transports is currently higher than it will be later.

Among the principal models making up the present pattern of aircraft production are, for the Air Force, the B-36 heavy bomber, the B-47 Stratojet medium bomber; the F-84 Thunderjet, F-86 Sabre, and F-89 Scorpion jet fighter; and the large C-97 Stratofreighter, C-124 Globe Master II, and C-119 Packet transports. Navy models include the AD Skyraider and AF Guardian carrier attack bombers; and three carrier-based jet fighters, the F3D Sky Knight, F9F Panther, and F2H Banshee.

Every month we are now turning out substantial quantities of the 600-mph class F-84G Thunderjet, equipped for in-flight refueling, the majority of which we are furnishing to the fighter units of our NATO partners, Mr. Steelman reported. Production of this jet fighter alone is exceeding our pre-Korea production rate for all fighters.

Production of improved, higher-powered versions of the 650-mph class F-86 Sabre is steadily increasing. The older models of this plane already hold an impressive combat record in Korea.

Superior new planes will soon be on the assembly lines to make up the production pattern of tomorrow. Others are now undergoing intensive tests before being ordered into quantity production. During April, for example, the Air Force announced the first flights of the B-52 Stratofortress and the B-60 sweptwing jet version of the B-36. The Navy A3D bomber and the Navy F3H and Air Force F-100, F-101, and F-102 jet fighters may all be familiar planes among tomorrow's military aircraft.

One of the outstanding aircraft-production accomplishments has been the transition from bench-made to quantity-production techniques in helicopter manufacture. These versatile aircraft have proved valuable in many military missions.

Aircraft Engines

Total aircraft-engine production has increased on the same scale as aircraft, having generally tripled the pre-Korea rate. Jet engines compose a steadily rising proportion of the total.

Through intensive work, entirely new and vastly superior engines, using less critical material, are coming off the production lines in increasing quantities. Their power is being increased constantly. The first U. S. jet plane was powered by two engines, developing only 1300 lb thrust each. The thrust of today's jet engines is generally five times greater, and far more powerful engines are under development.

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

TANK-AUTOMOTIVE

Official acceptance by the Army late in March of the M47 Medium Tank for issue to U. S. and NATO troops signalizes the fact that the tank-automotive program has cleared its greatest hurdle.

Field tests have demonstrated conclusively the combatworthiness of the M47. In the opinion of the Army, the M47 tank is better than any known medium tank produced by any other country. A new integrated fire-control system, which calculates the range and speed of the target and automatically applies the data to the gun, allows the gunner to fire before the enemy can even calculate accurately the M47's position.

Even newer tanks, the M48's, will be rolling off production lines before the end of the year.

AMMUNITION

When the Korean operation began, the Army had large stocks of some types of World War II ammunition. These stocks were drawn upon to meet Korean needs and only moderate orders were placed for new production. In December, 1950, additional funds for ammunition were authorized and new production was undertaken. The heavy fighting in the early summer of 1951 drew down our stocks and led to a substantial raising of production schedules. By September, production of the major critical types of ammunition will be above the highest average rates of consumption experienced in Korea to date and output will continue to climb.

ELECTRONICS

Production of electronics is now running at seven times the low rate at the time of Korea, when less than five per cent of the major military electronic items now in the program were in production. During the past six months, 52 major electronic items were first brought into volume production.

The greatest developments have been in the field of radar. Of the 81 major items of radar equipment currently under contract, not one was being produced at the start of the Korean action. Radio has shown almost as much change as radar, with only three of the major items presently under contract having been produced prior to June, 1950. All of the sonar underwater detection devices are also new.

GUIDED MISSILES

Guided missiles, though one of the smaller components of the procurement program in terms of dollar cost, represents one of the most intensive research and development efforts. Activity to date has been concentrated on design, experiment, and testing, with limited production scheduled for the near future.

Guided missiles may be grouped into four general types: Surface-to-surface missiles, surface-to-air missiles for use by both land and sea forces, air-to-air missiles, and air-to-surface missiles.

The impending availability of guided missiles will introduce changes in warfare, both offensive and defensive, at least as great as those wrought earlier by the advent of the airplane. A missile developed by the Army, for example, is capable of taking off from the earth and tracking and destroying an airplane 10 miles away at an altitude of more than six miles. One of the Navy's air-to-air missiles is effective at a distance of three miles.

OTHER WEAPONS

Numerous new models of other weapons are being produced, though not yet in substantial quantities. These include the higher-velocity, electronically controlled antiaircraft guns for use on land and ships, and highly sensitive fire-control equipment, designed to locate incoming enemy aircraft within the moments allowed by present aircraft speeds.

Among improved models which are already at good production rates, are guns for combat vehicles, including the faster and more maneuverable tanks and self-propelled artillery.

To meet requirements for the current program, and to provide a broader mobilization base, commercial firms have been given contracts for several major weapons heretofore manufactured only by Army arsenals.

MILITARY CONSTRUCTION

Since 1948, Congress has authorized $9.3 billion (of which $8.4 billion has been authorized in 1951 and 1952 fiscal years) to the Department of Defense for construction of military installations. On April 30, $800 million of the construction projects authorized since 1948 had been completed and $6 billion were under way or in the design stage. It is estimated that 80 per cent of the construction work now under way will be completed and ready for use before Dec. 31, 1953.

Some of the larger domestic projects are a $50 million Army Signal Depot at Tobyhanna, Pa.; a $70 million project at the Naval Ammunition Depot, Shumaker, Ark.; and the Air Force's $157 million Arnold Engineering Development Center at Tullahoma, Tenn. Major air-base-construction programs are also under way at Okinawa, Guam, Greenland, French Morocco, and other overseas locations.

SHIPS

More than 100 shipyards in the nation are now at work in the naval rearmament program, including craft for the Army nd Air Force.

During the past nine months, 19 combat vessels, including minesweepers, and many more auxiliary vessels have been launched. Six combat vessels and many more auxiliary vessels have been completed. Work has also progressed on the large conversion program to incorporate more modern methods of propulsion, newer weapons, and electronic devices in existing vessels.

The keel for the large aircraft carrier, *Forrestal*, was laid in July; the keel of the first atomic-powered submarine was laid in June; and two fast-attack submarines were recently completed. Four more of the latter are under construction.

Five large, fast, and powerful destroyer-leaders, a new class of ships which will add greatly to antisubmarine strength, have been launched in recent months. All of these vessels, equipped with new electronic devices for hunter-killer missions, are expected to join the fleet by the end of 1952.

The heart of the Navy's program for converting Reserve Fleet vessels to undertake present-day missions is the conversion of carriers of the *Essex* class to enable them to handle the heavier and faster modern jet aircraft. Work has been completed on four of these carriers, eight more are under conversion and work is to begin soon on two more.

Two cruisers are being converted into the Navy's first ships for launching guided missiles, with extensive modification of superstructures to allow installing missile launchers in place of part of the conventional shipboard armament.

ATOMIC-ENERGY EXPANSION

In May the President requested funds from the Congress to begin a further major expansion of the production facilities of the Atomic Energy Commission. This expansion, which had been under consideration for some time, is made necessary by the fact that the Soviet Union has shown no disposition to co-operate in an international program for control of armaments. The United States, nonetheless, stands ready to move ahead on an effective plan of international control of atomic

energy, but in the absence of effective international control of atomic energy the security of the free world demands that we maintain and increase our leadership in this field.

The new facilities will provide greater capacity for the production of fissionable materials and for the fabrication of such materials into atomic weapons. The cost of the new facilities is estimated at $3.9 billion, compared to the $5.5 billion approximate value of facilities previously built, under construction, or authorized.

Industrial Gear Drives

AN UP-TO-DATE picture of the conventional types of industrial gearmotors, speed reducers, and speed increaser gear drives that are available, was given by C. B. Connell, section engineer, gearing division, Westinghouse Electric Corporation, Pittsburgh, Pa., at a Machine Design Division technical session during the 1952 ASME Spring Meeting held in Seattle, Wash.

SPEED REDUCERS

A geared speed reducer, Mr. Connell said, is generally understood to be a gear drive which is completely separate from its prime mover. In a gearmotor, the prime mover is an integral part of the gear drive. In a speed reducer, the prime mover is a completely separate item and is connected to the high-speed shaft of the reducer by means of a coupling, chain sprocket, belt, and sometimes by other gearing.

The industrial speed-reducing field as defined by the American Gear Manufacturers Association (AGMA) is understood to be that field where pitch-line velocities are limited to a peak of 4000 fpm, or pinion speeds not in excess of 3600 rpm. The type of gearing employed may be single-helical, double-helical, herringbone, bevel gear, or worm gear, depending upon the desires, experience, and manufacturing equipment of the particular manufacturer. Commercial speed reducers are generally either single, double, or triple reduction in nature. Quadruple-reduction speed reducers are listed occasionally by some manufacturers. Above the quadruple reduction the needs are so few and limited that for all practical purposes these reducers do not exist, as a commercial item.

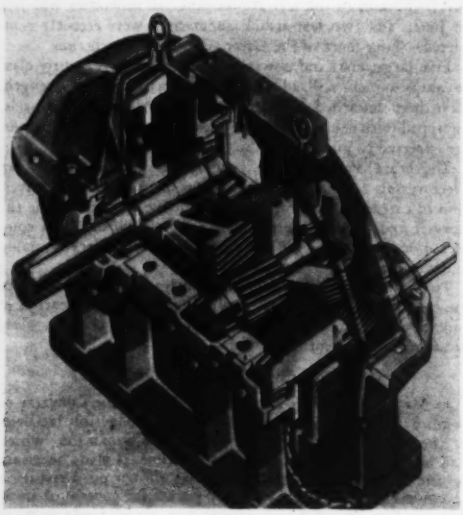

FIG. 1 HORIZONTAL-TYPE DOUBLE-REDUCTION SPEED REDUCER

Speed reducers are built in numerous conventional designs, to fit certain typical installations. Reducers of the helical and herringbone type are built with shafts parallel, either horizontal or vertical. Speed reducers with the shafts perpendicular to each other are normally built with bevel gears (straight or spiral) or with worm gears.

Double-reduction reducers may be obtained in the same types but in addition, the horizontal type of double-reduction speed reducer is commonly built in either the "tandem" or "box type." A horizontal-type double-reduction speed reducer is shown in Fig. 1.

GEARMOTORS

A gearmotor is understood to be a geared drive wherein the power source is an integral part of the equipment. Gearmotors may be speed increasers although normally they are speed reducers. The power source is generally an electric motor. Most often it is bolted to the gearcase housing, and contains the high-speed pinion on the same shaft as the motor rotor, with no coupling between the motor and the gearing.

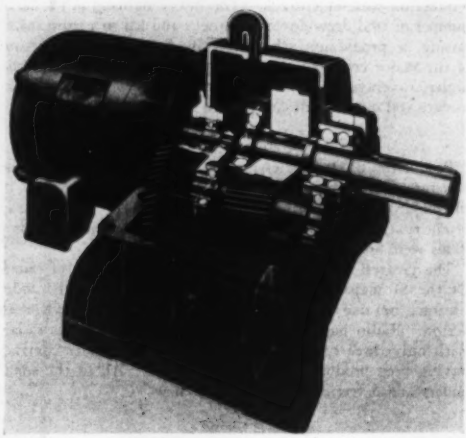

FIG. 2 GEARMOTOR WITH HORIZONTAL SHAFT

Gearmotors are normally available in single, double, and triple reduction, and are less frequently listed in quadruple. They are available with helical, bevel, and worm gearing. Helicals are used for parallel shaft arrangements, and the bevel and worm gearing for angular changes of shaft direction. Gearmotors are available with the output shaft in either the horizontal or vertical plane. One with a horizontal shaft is illustrated in Fig. 2. In capacities, they are available in sizes which include using the 445 standard NEMA motor frame. This gives horsepower capacities up to 75 based on a four-pole 60-cycle motor, and proportionately less for the slower motor speeds. They are built with a-c and d-c motors and can be supplied in various types of motor enclosures. For ratings larger than 75 hp, gearmotors are sometimes built although not listed as a standard commercial item. Since the motor is overhung on the gearcase, in most designs, when motor frames larger than the 445 NEMA frame are involved, the advisability of overhanging such large motors must be

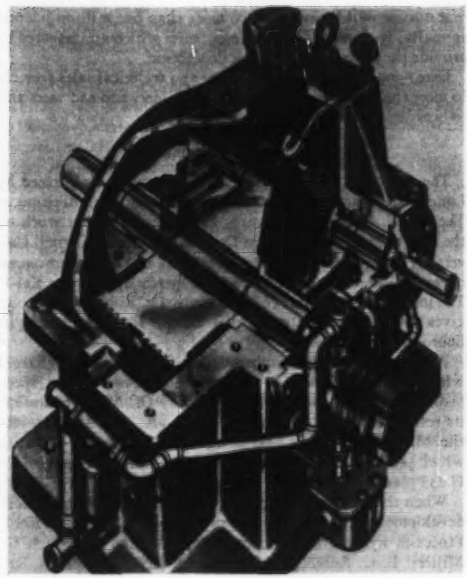

FIG. 3 COMMON TYPE OF HIGH-SPEED GEAR DRIVE

considered. Gearmotors may be obtained with extended motor shafts used on floor-mounted or motor-mounted brakes of various standard types. They are used in numerous positions such as floor, side wall, or ceiling with either foot or flange mountings.

HIGH-SPEED GEAR DRIVES

High-speed gear increasers are defined in AGMA Standards as that class of drives which operate with pinion speeds in excess of 3600 rpm, pitch-line velocities of 4000 fpm or greater, or whose journal velocities are 1500 fpm and higher. No limit is placed on the maximum speeds to which the AGMA high-speed standards are applicable. It is a question of experience and judgment on the part of each manufacturer as to how high in speed he can safely operate with his particular design, and methods of manufacture employed. It is known that problems arising from machining errors, design limitations, temperature, vibration, lubrication, and the like, multiply quite rapidly as speeds increase, and special care must be taken in the manufacture of a gear and its housing intended for this class of service. High-speed drives are known to be in service which operate successfully for speeds above 30,000 rpm and pitch-line velocities above 23,000 fpm. Applications of this type are unusual, but they do exist.

Fig. 3 illustrates a common type of high-speed gear drive. The lubricating pump, cooler, strainer, spray, pressure gage, pressure-relief valve, large breather, sleeve bearings, double helical gearing, and solid heavy housing are typical of drives for this type of service.

CONCLUSION

Attempting to predict the trend of possible future developments, Mr. Connell said that unquestionably, loads and speeds will increase and it is expected that greater power will be packed in ever-decreasing spaces. Materials, heat-treatments, cutting tools, and manufacturing methods will be improved which will permit higher loading. With the development of better tools, it will be possible to work to higher values of hardness and obtain greater accuracies which are necessities in highly loaded gearing. Unquestionably, a great deal of information is being acquired at the present time about higher-hardness gearing in the aircraft industry. Some of this will be expanded and used in the gearing field, in general. It is expected that the use of higher hardness with its resultant greater loads will decrease the practical ranges for the use of single, double, and triple-reduction drives. By that, it is meant that any one of these types will not extend over as wide a range as was possible in the past. This is reasoned from the fact that as the physical properties of a material are increased by working to higher values of hardness and thereby permit greater loading, the condition of deflection becomes worse because of the increased loading. Deflection is a function of diameter, modulus of elasticity, and loading, and since the loading is increased, the alternative is to use less gear ratios in order to stiffen the pinions.

Because of the expected reduction in gear-case sizes for a given capacity, which is predicted for the future, a greater number of slow-speed drives will require artificial means of cooling. The amount of heat which a case can dissipate by natural means is a function of the case area, and the allowable temperature increase above ambient, among other factors. By working to higher operating temperatures than are common today, some increase in capacity may be attained. After the maximum in safe operating temperatures has been reached, it will be necessary to use artificial cooling more extensively than is prevalent today.

Rare Earths

THE so-called rare earths, although largely ignored until 1945, when they were revealed as important in the development of atomic energy, are now not so rare and can be considered for new uses in industry, according to the April, 1952, issue of the *Industrial Bulletin* of Arthur D. Little, Inc. These metallic elements together comprise nearly a fifth of all the known naturally occurring elements, yet constitute only about 0.005 per cent of the earth's crust. One of them, cerium, is more abundant than tin, silver, or gold, and several fairly rich deposits of rare-earth materials are known both in the United States and elsewhere.

The rare earths are all much alike chemically and hence difficult to purify, a fact which has retarded commercial development of all but a few of them. Recently, however, methods have been worked out for separating and purifying rare earths in solution by flowing the solutions through beds of "ion-exchange" resins, which adsorb the elements one after another as the solution progresses through the bed. This produces relatively small quantities of pure materials; commercial separation is done by fractional crystallization or solvent extraction. The rare earths were originally valuable in atomic research because the chemical methods for separating them could be used, with modification, in purifying the equally similar fissionable elements. Now they continue to be valuable because their atoms differ so little from each other that these small differences reveal new subleties of atomic structure.

Cerium, it is pointed out, is the commonest rare-earth element, and because it ignites easily has long been used as the active ingredient in flints for cigarette lighters. Mixed in small amounts with aluminum, metallic cerium and its alloy, misch metal (a mixture of cerium and other rare earths), makes possible sound aluminum castings and improves the forgeability of stainless steels. It is also used in the production of nodular

cast iron. An alloy of magnesium, zirconium, and cerium, developed for jet-engine parts, may become the biggest market for cerium. In the optical industry, cerium oxide is better than rouge as an abrasive in polishing lenses and mirrors. Glass containing a cerium salt is used for microscopes and periscopes in "hot" chambers of atomic-energy installations, since the glass does not darken when exposed to radiation. Cerium nitrate is used in the ceramic and textile industries and in the manufacture of Welsbach gas mantles.

The oxide of lanthanum has found considerable use in making a special optical glass of high refractive index for cameras and other instruments. In its ores, lanthanum is always found mixed with other rare earths and is separated from them for commercial use; it may also be obtained as a fission product in the splitting of uranium, thorium, and plutonium. Lanthanum itself has an intensely radioactive isotope which serves as a strong source of gamma radiation. This radiation, the same as that produced by "hard x-ray" machines, is used industrially for nondestructive testing and for inspection of metal parts.

Neodymium is the third most familiar rare earth. Its salts are used chiefly as a coloring agent in the ceramic and optical industries; they are particularly useful in goggles worn by glass blowers, since they filter out the bright yellow light of sodium. Praseodymium and ytterbium also have salts which have some use in the ceramic industry. Samarium can activate fluorescent phosphors, and has found some practical application in this field. Salts of gadolinium are strongly magnetic and one of these salts was first used to obtain temperatures within a few tenths of a degree of absolute zero.

Most of the other rare-earth elements are notable principally as monuments of chemical ingenuity, with their exotic names often commemorating the place of discovery. Ytterbium, terbium, and erbium are all named for the town of Ytterby in Sweden; holmium for Stockholm; lutecium (via Latin) for Paris; and thulium for the far north. Possibly the most aptly named rare earth is dysprosium, derived from the Greek work meaning "hard to get at." Odd though these names sound now, the metals themselves should soon become more familiar, the *Industrial Bulletin* states. As ways are found to produce them more cheaply they will become more generally available for scientific research, and as their properties are better understood many industrial uses are likely to develop.

Fluorocarbon-Type Plastics

PLANS for the production in expanded commercial quantities of Kel-F, strategic fluorocarbon-type plastic with extraordinary resistance to heat, moisture, and chemical action, were announced at a press conference in New York on June 19, 1952, by Warren L. Smith, president of The M. W. Kellogg Company, subsidiary of Pullman Incorporated. Mr. Smith revealed that new production facilities, representing an initial expenditure of about $1,000,000, are now under construction at the Jersey City, N. J., development and manufacturing center of Kellogg, and are scheduled to go into operation before the end of the year.

Mr. Smith said that Kel-F had its origin in connection with the development of special materials for the Oak Ridge atomic-energy plant and that it had been produced on a commercial basis by Kellogg since 1947.

Work in laboratory and pilot plant in developing this thermoplastic has resulted in a continuous manufacturing process, Mr. Smith announced. Increased demand for the product, three previous price reductions, and the evolution of this new process have made production in expanded commercial volume now practicable. Upon completion of the new plant, he stated, current output will be increased to more than one million pounds annually, with manufacturing economies which are expected to provide the basis for further price reduction.

Extension of technical consulting and technical sales services to meet the growing requirements of molders and end users and to broaden use possibilities is planned.

PROPERTIES DESCRIBED

The properties of Kel-F were described and demonstrated by Louis F. Rubin, manager, chemical manufacturing division of The M. W. Kellogg Company. Dr. Rubin said that work on the new product started when Dr. W. T. Miller of Cornell University, produced laboratory quantities of polytrifluoro*monochloro*ethylene, the plastic known commercially today as Kel-F. The inclusion of that one chlorine atom, Dr. Rubin pointed out, gives this material properties that make it stand out among its fluorocarbon relatives.

An M. W. Kellogg Company subsidiary, he said, charged with the design of the Oak Ridge gaseous diffusion plant, specified the use of the material developed by Dr. Miller because of its resistance to highly corrosive materials. Dr. Miller joined the Manhattan Project and designed a pilot-plant operation which produced enough material for the immediate needs of the U-235 plant.

When the war was over, Kellogg undertook the commercial development and introduction of various polymers of Kel-F. Processes were developed for their production for which Dr. Miller; L. C. Rubin, then director of Kellogg research; and A. J. Chernosky, chemical engineer, were largely responsible.

With production processes proved and Kel-F released from security restrictions, a new division was organized to specialize in chemicals manufacturing and the first commercial plant for its production was built.

While this plant was building, the aid of the country's leading molders was enlisted in exploring applications and developing techniques by which the material could be readily molded on all types of standard production equipment. Other forms of the material were also developed, including plasticizers (for combining with regular Kel-F to obtain varying degrees of flexibility), oils, waxes, greases, and dispersions. The latter, dispersions, have a great variety of applications in protecting more vulnerable materials from virtually any corrosive material. Thin films of Kel-F dispersions may be applied by spraying, dipping, or painting, Dr. Rubin said.

In the earlier stages of commercial growth, the product's unique properties were employed to solve long-standing materials problems. Some of these applications are still restricted because they concern components of military equipment. However, Dr. Rubin was able to describe several applications of the new material, including a small electronic-transformer terminal. The specifications on this device had never been met until one molder used Kel-F as the insulating material to surround the metallic connectors. Here the material's ability to withstand high and low temperature, its dielectric strength, and its lack of moisture absorption were "must" factors. But the principal reason for the molder's success in meeting the Army specifications for the first time was moldability—the fact that a hermetical seal could be obtained between the insulation and the metal inserts.

Another instance of a long-standing materials need, noted by Dr. Rubin, was in the field of valves. The efficiency of the diaphragm-type valve in certain chemical-processing flow-control applications depends on the diaphragm, he said. Use of Kel-F diaphragms in these valves—providing the necessary flexibility over a wide temperature range with the addition of complete inertness to even the most corrosive chemicals—opened a host of new service applications for the valves.

Complicated bases for many-pronged electronic tubes were another product for which the new material provided a combination of mechanical strength, the ability to be injection-formed in a most complicated mold, and to produce at the same time a hermetical seal between metal insert and plastic base, stability over a wide temperature range, from 320 below zero to 390 above, dielectric properties, and complete lack of moisture absorption.

One recent application described by Dr. Rubin was a lining made for a large chemical vessel handling an extremely corrosive acid. In effect, a complete vessel itself, the liner was completely fabricated from Kel-F sheet and tubing, and measures 18 ft long × 3 ft in diameter. The object is to protect the costly metal vessel from any possible corrosive attack.

The principal physical properties of Kel-F were described by Dr. Rubin as follows:

Chemical Inertness: No effect has been observed after prolonged exposure to concentrated sulphuric, hydrofluoric, and hydrochloric acids; to strong caustic; to fuming nitric acid, aqua regia, and other vigorous oxidizing materials. It is equally resistant to most organic solvents.

Electrical Resistance: The material has high resistance to electricity and is a poor conductor of heat. Its electric properties are superior to most plastics. The dielectric constant is in the range of the best available materials.

Zero Moisture Absorption: The results of continuous tests have shown zero water absorption. Another unusual property is its exceptional resistance to wetting by water. It is also unaffected by high humidity and tropical exposure.

Wide Temperature Range: It has satisfactory properties over a temperature range of 710 F—from a low of —320 F (liquid nitrogen) to a high of 390 F.

Moldability and Machinability: Fabricating characteristics are good. It can be molded by compression, transfer, injection, and extrusion. It can be readily punched, drilled, or otherwise machined to close tolerances.

Some typical proved applications for the material mentioned by Dr. Rubin are: Valve diaphragms, valve seats and gaskets, resilient-core "O" rings, thin-film gaskets, glass-filled valve seats, drum and tank liners, flexible noncorroding containers, "O" rings, "U" packing, washers, coated wire, coil forms, tube-socket bases, UHF aerial supports, rotary electric switches, electronic caps, multilead terminals, antenna bases, transformer terminals, and machined electric and chemical fittings.

Dr. Rubin said that standard materials for fabricating are available in the form of molded sheets (thickness, $^1/_{64}$ in. to $^1/_2$ in. and diameter in disk form to 45 in.); extruded rod (diameter up to 1 in. and length to specification); molded rod (diameter up to 4 in. and length to 12 in.); extruded tubing (diameter up to 2 in. and wall thickness and length to specification); thin film (extruded as lay-flat tubing) (thickness 0.002 in. to 0.010 in., width, lay-flat up to 20 in., total width to 40 in.); and strip (thickness, 0.010 in. to 0.125 in., width, 2 in. to 4 in., and length to specification).

FIELDS OF APPLICATION

In an effort to visualize the future of Kel-F, Dr. W. E. Hanford, vice-president, research and development, The M. W. Kellogg Company, discussed some possible applications in the fields of electronics, aviation, packaging, the food industries, and lubrication.

The trend in the electric and electronics industry is toward building smaller and more compact units, in which insulation is an important factor. Dr. Hanford said that if it were possible to run the operating temperature of an electric motor up to 300 F, three times the horsepower could be obtained from a given motor casing. Many operations could not be carried out at this high temperature but it represented the extreme which can be reached with Kel-F-type insulation. Hence design and construction changes in such electric equipment as refrigerators, air conditioners, and television and radio sets, may be forthcoming.

Equipment used in aviation must have a wide working range of temperatures to satisfy conditions existing at ground level and at high altitudes. For the future the development of an elastomer based on fluorocarbon compounds, which will have the elasticity of rubber over a temperature range of —80 to +250 F is a possibility.

Better containers for corrosive liquids, both chemicals and food products, and for medicinal products, especially those which require sterilization after packaging, are needed. The packaging industry, he said, still has a great desire for materials with the properties of metals, that is, strength, resistance to corrosion, but which can be shipped in a collapsible form. Hence the new material may play a major part in all of the future packaging of products in America.

Because of its low water absorption and chemical inertness, Kel-F offers an ideal material for the packaging of foodstuffs, Dr. Hanford said. Its low-temperature properties make it ideal for deep-freeze operation. One can visualize that the frozen food of the future might be handled as follows: The vegetables or meat would be wrapped by the producer in Kel-F bags. However, in addition to putting in just the vegetables or the meat, the producer would add the other condiments and liquids necessary for the final cooked dish. This frozen package would then be available at the local grocery store. The housewife would simply take the package and, without opening it, cook it. The dinner would be removed from the stove, still encased in its Kel-F bag. The operation of serving dinner is just as simple—simply split the bag and serve.

NEW LUBRICANTS A POSSIBILITY

Because of the difference of the order of magnitude of the stability of this new class of compounds as compared to the hydrocarbons, Dr. Hanford visualized the possibility of preparing lubricants which would have perfect properties, such as stability to oxidation, low vapor pressure, high degree of oiliness, and high viscosity index. This goal has not yet been achieved, he stated. Two or possibly three of these four properties have been achieved, he claimed, but a product with a good viscosity index has not as yet been developed. What must be accomplished to reach this objective was known but as yet it had not been possible to put the molecules into the desired configuration.

"All that has been accomplished in the past hundred years in the field of organic chemistry has suffered from the limitation that the products are subject to the same oxidative degradation as those produced by nature," Dr. Hanford stated. "The same limitation has, to a lesser extent, existed in the metallurgical field except for the precious metals, gold and platinum. In the fluorocarbon field we have developed, for the first time, the counterpart of the precious metals with regard to their resistance to attack by the normal, natural phenomena. We can, therefore, expect great developments with these new building blocks in the next ten to twenty years."

In his concluding remarks, Dr. Hanford said: "We feel that we can predict with some safety that fluorocarbons and fluorohalocarbons will play a major role in the future in the electric industry, the food industry, the packaging industry, the wearing-apparel industry, and the medical profession. The extent to which these products will be used will depend on the technical skill of American industry to lower the price of these products."

Tube-Extrusion Process

LATE in 1951 The Babcock & Wilcox Company put into operation the first American extrusion press having the speed and other design features necessary to take full advantage of the Ugine-Sejournet Hot Extrusion Process. This was the culmination of a long period during which more and more companies had become interested in this process.

Since the beginning of the year, this plant has extruded B & W Croloys 18-8S (Type 304), 18-8STI (Type 321), 25-20 (Type 310), 16-13-3 (Type 316) and Croloy 27 (Type 446), pure molybdenum, and pure titanium successfully. Noteworthy also was the extrusion of a tube from a round-cornered square continuous cast billet, wherein a finished tube was produced from molten steel in just three operations.

The Ugine-Sejournet Process, using glass as a lubricant, is the result of research and development work at the Persan, France, plant of Comptoir Industriel d'Etirage et Profilage de Metaux, dating back to 1940. Over this period of years the process was studied from the standpoint of the form of glass applied, the metal flow, the die analysis and design, the heating, and the desired speed and the required pressures of extrusion until it evolved as a practical method for the production of solid shapes and tubes by the extrusion process.

The most significant discovery, and the one which had a revolutionary effect on die life and surface quality, was the substitution of glass for the carbonaceous materials previously used as a lubricant. The glass, melting on contact with the hot steel, prevented seizing of the billet and tools, and insulated the tools from the heat of the billet. Of utmost importance in the rate of production, the excellent lubricating properties of the glass reduces the friction and makes it possible to increase the billet length. Once the number of extrusions per hour has been determined, the length and consequent weight of the billet determines the tons per hour.

In the extrusion of tubing, a hollow billet is confined in a container between the ram of the press and the die. Extending from the ram is a mandrel which passes through the billet and the die. As the ram moves forward, Fig. 4, the metal is squeezed out between die and mandrel with the die determining the external contour and the mandrel the internal contour.

Although it is possible to produce the hollow billet by forcing the extrusion mandrel through it prior to extrusion in the same press, this method has limitations with regard to mandrel strength and stiffness. An alternative method used by CIEPM, and adopted by The Babcock & Wilcox Company Tubular Products Division, makes use of a separate vertical press for piercing.

The benefits resulting from the type of separate piercing press used in this process are primarily concerned with the concentricity of the final tube. Obviously, this concentricity depends on the concentricity of the pierced billet just prior to extrusion.

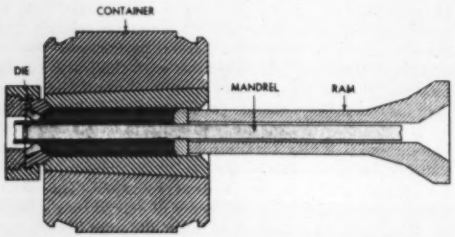

FIG. 4 PRODUCTION OF TUBING BY EXTRUSION

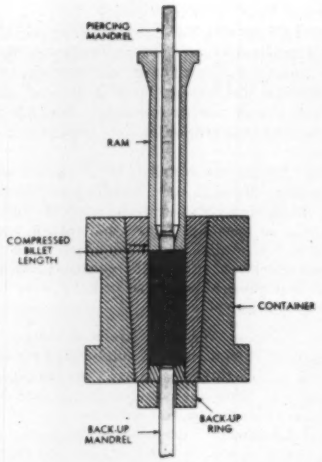

FIG. 5 SEPARATE VERTICAL PRESS USED FOR PIERCING

In a separate press, it is possible to pierce a slightly oversized hole in the billet. Since this allows the use of a larger and consequently stiffer mandrel, much less mandrel wander results at the far end of the pierced billet. The importance of using the larger-diameter mandrel becomes apparent when it is recognized that the extrusion mandrel length-to-diameter ratio may be in some cases approximately 30 to 1.

The design of the press provides from compression of the billet to make it fill the container prior to piercing, Fig. 5. This prevents eccentric piercing resulting from the billet lying off to one side of the container. When the billet is compressed to fill the container completely and the mandrel is accurately guided down the center with no tendency to be pushed off-center because of one-sided distribution of metal, the results will be a concentric pierced billet.

By the use of a separate piercing press, it is possible to place the billet in the extrusion press so that the first end pierced is placed farthest from the ram during the extrusion operation. At this point the extrusion mandrel is flexible and will need convergence of concentric metal to hold it on center. As the ram approaches the die, the effective length of mandrel becomes less and its stiffness will provide a corrective effect on concentricity.

Thus there are three separate concentricity correctives resulting from the use of this piercing press:

1 Precompression of the billet fills the container and prevents random off-center displacement of the billet and consequently the mandrel.

2 The stiffness of the oversized piercing mandrel gives more concentric piercing throughout the entire length of the billet.

3 Placement of the pierced billet in the extrusion press so that the very accurately pierced top end is extruded first when the extrusion mandrel is long and not stiff enough to hold center without the convergence of concentric material to help it.

The arrangement of a plant at the B & W Company in Beaver Falls, Pa., specifically designed for the production of tubular or solid shapes, is shown in Fig. 6. The billets are charged into a rotary-hearth gas-fired furnace. After heating, if they are to be made into tubing, they are rolled across a "glass-pickup"

table to the piercer charging device, or if they are for solids they by-pass the piercing operation and go directly to the salt-bath furnace. The piercing is done with glass interposed between the billet and piercing mandrel and depending on analysis, either with or without glass between the container and the billet. The piercing operation consists of precompression, Fig. 5, piercing to within an inch of the cylinder bottom which is closed by a backup mandrel, Fig. 7, and finally completing the pierce when the backup mandrel retreats.

The pierced (for tubes), or unpierced (for solids) billet is charged into a metal basket which supports it in a rotary salt-bath furnace. A hook on the surface of a large drum lowers the basket onto a carrousel support, and a cam-type surface on the drum rotates the carrousel forward and indexes the next basket into position where the hook will be in perfect position to lift it from the bath. After circling through the furnace, the basket is lifted out by the same drum and the billet discharged into a trough on a transfer car to the extrusion press.

The transfer car has an inclined surface on which a fiberglas mat is placed. As the car travels toward the extrusion press, the billet is raised out of the trough and rolled down the inclined plane fusing to the fiberglas mat and picking it up. When the transfer car reaches the end of its travel, the billet has rolled into a trough at the front end. The trough lines up with the container bore, and the billet is automatically pushed into the container.

Previous to this time, a fiberglas "sock" has been slipped over the mandrel and a glass cartridge placed against the die. With the mandrel lubricated by the fiberglas sock, the die lubricated by the cartridge, and the container lubricated by the glass picked up by the billet in passing across the transfer car, metal-to-metal seizure is prevented on all surfaces.

The actual extrusion takes place in from 2 to 4 sec, yielding a piece from 20 to 60 ft long depending on the size of billet and area of extruded section. The tube may be cut into shorter lengths on a hot saw and either quenched or rolled onto a cooling bed, depending upon analysis.

For the higher-grade alloys, it is claimed that tubular extrusion enjoys a considerable economic advantage over rotary piercing particularly where cold reduction takes place subsequent to the production of a hot-finished tube. The advantage in this case is the ability of extrusion to accomplish the following: (1) Produce a tube free from breaks in the surfaces such as may be found on a rotary-pierced tube; (2) produce smaller lighter-walled tubes than rotary piercing thereby eliminating cold passes; (3) produce high-alloy tubes at a faster rate per man-hour than is possible by rotary piercing.

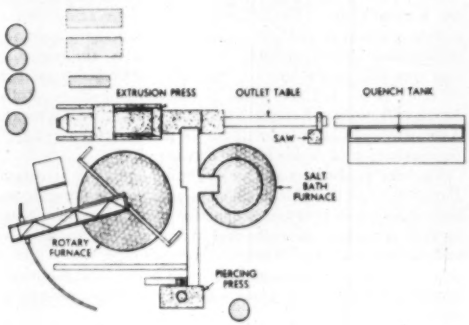

FIG. 6 ARRANGEMENT OF PLANT DESIGNED FOR PRODUCTION OF TUBULAR OR SOLID SHAPES

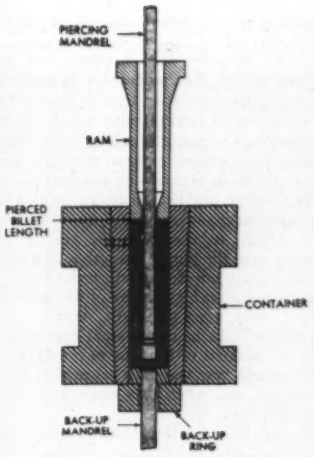

FIG. 7 METHOD OF PIERCING OPERATION IN VERTICAL PRESS

A general feature of economic importance is the ability of the extrusion process to produce special cross-sectional shapes either tubular or solid. In the case of solid shapes, this means of production compared with rolling is particularly economical in terms of tool and change-over costs for small quantities. Extrusion in tubular form may be made in a variety of shapes other than circular with fins or wings of various sorts on both the interior and exterior surfaces.

Atomic Engine

UNDER contract with the Atomic Energy Commission and the Navy Department, the Westinghouse Electric Corporation is building both the nuclear reactor—or atomic "boiler"—and the associated propulsion equipment for the U.S.S. *Nautilus*, atomic-powered submarine whose keel was laid June 14, at Groton, Conn. The submarine will be built by the Electric Boat Division of the General Dynamics Corporation.

The keel laying came $3^1/_2$ years after Westinghouse first was assigned the job of building the first "atomic engine." It was on Dec. 29, 1948, that the Atomic Energy Commission announced that a contract had been entered into with Westinghouse "for the construction of an experimental nuclear reactor to meet specifications for eventual use for ship propulsion." The detail design is being carried out jointly by the Argonne National Laboratory of the United States Atomic Energy Commission and Westinghouse.

Although the work has been cloaked in silence, Westinghouse has been able to report "considerable progress" in this major engineering assignment. Research, design, and production work still is going on today at the Bettis Field site near Pittsburgh. A "land-based prototype" of the atomic engine is being built at the National Reactor Testing Station near Arco, Idaho. This experimental model is the basic pattern for the unit Westinghouse has been selected to build for installation in the U.S.S. *Nautilus*.

The land-based prototype consists of a nuclear reactor, all its controls, the water for extracting heat from the reactor, and the means for converting this heat energy to power. This

steam-propulsion system follows marine practice except for measures taken to reduce dimensions and weight.

The work by Westinghouse, Argonne, and participating industrial firms already has produced a number of first-grade technical accomplishments that are side issues of the reactor itself—achievements of lasting value which, sooner or later, can be disclosed for the general benefit of our industrial society. These include development of new materials and increased knowledge in the fields of corrosion and heat transmission.

One of the toughest problems of design of this nuclear power plant, Westinghouse engineers explain, was to find suitable materials with which to construct the reactor core. These materials must have the proper strength at the operating temperatures, they must not deteriorate under intense radiation, and they must not absorb too many of the precious neutrons. Every material used, every part built, must be examined with great care in the light of the unusual operating conditions. This means the analysis of behavior of conventional materials and also of strange new materials when they are exposed to nuclear radiation, and when they encounter other heretofore unknown conditions.

Classified models and full-scale mock-ups, many of transparent plastic, set up at the Argonne National Laboratory and at Bettis Field, have been of invaluable help in determining how well parts go together and also in enabling the engineers and technicians to visualize the mechanical elements, many of them the first of their kind.

British Aviation

9750-Lb-Thrust Jet Engine

THE Olympus, a new British jet engine, said to be the most powerful in the world, has been taken off the secret list. Made by the Bristol Aeroplane Company, Ltd., it delivers a 9750-lb thrust—the equivalent of over 17,000 hp at 600 mph.

The United States showed its interest shortly after the Olympus' first test-bed demonstration, when the Wright Aeronautical Corporation, backed by the U.S. Government, asked for a license to develop the engine type in the United States. An agreement between the two countries was announced late in 1950, and six months later it was revealed that the Olympus was the engine concerned.

The thrust figure of 9750 is the published rating of this powerful new jet—the first of what is known as the "two-spool" type—but it is confidently expected that an even higher performance figure will materialize during the new engine's comprehensive development program.

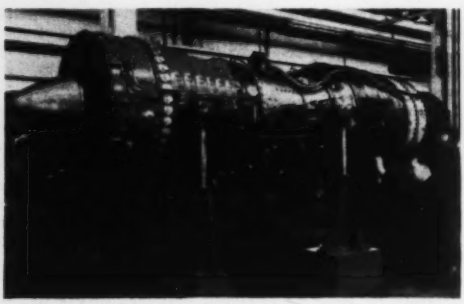

FIG. 8 BRISTOL OLYMPUS TURBOJET

Information available shows that in no other country today is there so powerful or so economical an engine in a comparable stage of development. The immense power of the Olympus is achieved with remarkably low fuel consumption and is the result of many months of research and development work by the company's Engine Division.

With turbines, as with piston engines, the key to high power and economical fuel consumption is the use of a high compression ratio. In designing the Olympus, engineers have solved the problem of obtaining a high compression ratio from axial compressors by "compounding" the use of two compressors in series. The Olympus consists basically of a low-pressure unit and a high-pressure unit, each having an entirely independent axial compressor and turbine. The low-pressure unit acts as a supercharger to the high-pressure compressor, and each is driven through concentric shafts by its own separate turbine.

This arrangement gives all the advantages of handling and easy starting obtained with engines of medium compression ratios, but yields the much lower fuel consumption made possible by the use of high-compression ratios.

Newspaper correspondents, after handling the throttle of the two engines installed at the test house, report that the latter accelerated from their idling thrust of about 1500 lb to the full thrust of nearly 10,000 lb in three seconds or less. They add that this is particularly surprising since this rapid acceleration can be had without special devices, simply by opening the throttle.

The new engine will be tested in a Canberra bomber and is expected to be flown at the Society of British Aircraft Constructors' flying display at Farnborough this month.

Further particulars of the Olympus are as follows: Diameter, 40 in.; length, intake to flange to exhaust flange, 124 in.; weight, 3520 lb; maximum thrust, 9750 lb; consumption (lb per lb thrust per hr) 0.766.

Jet and Turboprop Airliner Production

Between now and 1955 more than 100 of Britain's gas-turbine mainline passenger aircraft (jets and turboprops) will be built for the world's airlines. The output will expand still further as more production capacity is built up.

Three different airline types are involved: the de Havilland jet Comet, in two versions—one powered by the de Havilland Ghost engine, the other by the Rolls-Royce Avon; the Vickers Viscount, powered by the Rolls-Royce Dart turboprop; and the Bristol Britannia, powered by Bristol Proteus turboprop engines.

The Comet is currently being produced at the rate of about one a month, and this is being steadily increased. When, in 1954, a second line of Comet production comes into operation in Northern Ireland at Short Brother's works, the output at that time will be doubled. The number of Comets at present on order is 51, and these will be delivered by 1955. Rolls-Royce will produce Avon jet engines to meet all orders for the Avon-powered Comet and will do so without in any way affecting production of Avons for the Services.

Viscount production at the Weybridge works is at present about one a month. Vickers hope to achieve four a month, and have plans for stepping up production to six a month. Much of this increased constructional work will be handled by subcontract, with final assembly at Weybridge, where a huge new shop—now almost complete—will be used for this work. It is reported that 54 Viscounts have already been ordered for delivery by 1955.

At Bristol, where 25 Britannia airliners are being built for the British Overseas Airways Corporation, tooling-up is well ahead for maximum production. Plans are also being

made for duplicating production elsewhere. Production of the Proteus turboprop engine is, of course, well up to the progress being made with the aircraft.

Delta Wing Twin-Jet Fighter

A new delta-wing twin-jet fighter, the Gloster GA-5, is Britain's supersonic answer to atomic attack, according to Percy Crabbe, spokesman for the Gloster manufacturers. "Although its speed, range, armament, and radar equipment are secret," he said, "it is clear that the GA-5 is better qualified than any other airplane in the world to destroy atom bombers." The plane, powered by two Sapphire jet engines, is the first delta-wing machine to go into production for the R.A.F. It is said to be the first operational fighter of its kind to be manufactured anywhere in the world.

FIG. 9 GLOSTER GA-5 DELTA FIGHTER

The triangular-shaped Gloster is a long-range, day-and-night all-weather fighter with extensive air-to-air radar search apparatus for seeking out an unseen enemy. Its two Sapphire engines have a combined thrust of 16,600 lb.

In addition to powering the new delta-wing, the Sapphire isspecified for the U.S. Glenn Martin-built version of the British Canberra intruder-bomber and for the advanced sweptwing version of the Republic Thunderjet fighter-bomber. The design of the Gloster's airframe—all working parts, fuel, and equipment contained inside one smooth envelope—plus its powerful engines, will enable it to exceed the speed of sound, it is reported.

Guided Missiles and New Weapons

Alongside production of aircraft for the fighting services, a large section of the British aircraft industry is at work on guided missiles. Test missiles and their engines are being produced for the Ministry of Supply.

The companies who have already been named as working in this field are: Bristol, de Havilland Propellers, English Electric, Fairey Aviation, Hawker Siddeley Group, and Vickers-Armstrongs. Production of guided missiles has been rated as "superpriority."

These firms are concerned mainly with the production of airframes and engines (ramjet, rocket, and jet types). Other companies are working on equipment. The vital "brain" of the missile, its electronic guidance system, is the responsibility of the electric, radio, radar, and instrument companies associated with the industry.

The missile will take over from the piloted aircraft for some high-speed work, because navigation, air-to-air combat, bombing, and violent maneuvering at these speeds must be done by automatic electronic machines and not by the human brain alone.

Work so far done on the missiles indicates that they are not only valuable as weapons—they may also make a considerable contribution to aviation transport in peacetime.

British work on modern-type rocket missiles goes back to 1936 when a program of research work known as "Projectile Development" was initiated. Since 1945 large numbers of missiles have been fired over Britain, but firing trials there are restricted by geographical conditions, particularly by weather and the short ranges available. In 1947 plans were made for opening a joint British-Australian testing ground in the Australian desert at Woomera. On this Long Range Weapons Establishment, 1200 miles of open desert are available for testing. Automatic observation posts, fitted with cameras, radio, and radar, monitor the flight of the missiles and check their elevation and trajectory.

In the next few months there will be a great expansion in the work at Woomera on weapons and their guidance systems. An Australian-built target aircraft has already been flown with a small British Armstrong Siddeley Adder jet engine, and British-built expendable engines and ramjets are shortly to be tried out in the air.

Autopilot

THE first automatic pilot with unlimited maneuverability is installed in the new F-94C Starfire jet warplane that the Lockheed Aircraft Corporation announced recently. It was developed by the Westinghouse Electric Corporation in cooperation with the Air Materiel Command's Armament Laboratory, Control Equipment Branch. Manufactured by Westinghouse's Air-Arm Division, the automatic pilot was described by Dr. Clinton R. Hanna, associate director of the Westinghouse Research Laboratories, as utilizing three "nontumbling" gyroscopes that are locked to the plane.

These gyroscopes, spinning at 12,000 rpm, follow the plane's movements during all maneuvers without any possibility of tumbling, Dr. Hanna said. They differ in this respect from the ordinary "position" gyro that is not locked to the plane and hence stubbornly resists any effort to change its direction of motion. As a result, former gyros were sensitive only to changes in angle of the plane, whereas the new autopilot equipped with "rate" gyros responds to the rate at which such changes take place.

Virtual finger-tip control, consisting of a single control knob, is provided by the flight controller of the autopilot. For normal flying, the autopilot is arranged for completely co-ordinated flight. To climb, the pilot simply pulls the knob back and the plane climbs at a constant rate, regardless of external conditions. To turn, he rotates the knob either right or left, the rate of turn depending on the amount the knob is turned, and the correct bank angle being automatically set.

For combat tactics, the pilot switches the autopilot to a stage of complete maneuverability. Dr. Hanna said that the control reacts to the pilot's signal in less than $^{1}/_{18}$ sec. He pointed out that at the high speed of modern planes, considerable force is required to move control surfaces such as elevators, ailerons, and rubber. To aid the pilot in manual flight, hydraulic controls multiply the pilot's effort some 15 times and convey it to the control surfaces.

The autopilot works through this same system in automatically piloting the aircraft. It is tied into the plane's radar and

instrument-landing system, helping it to track enemy targets automatically and to land in bad weather.

The autopilot is suitable not only for military aircraft, but also for large and small commercial planes. Radio-controlled, it can also serve to direct the flight of guided missiles and pilotless aircraft.

The F-94C jet plane, now being produced by Lockheed for the U. S. Air Force, has a top speed of "more than 600 mph," and is the first U. S. fighting plane ever to have all-rocket armament. It carries twenty-four 2.75-in. rockets.

Ductile Titanium Production

HOW titanium metal is made in 200-lb batches at the Bureau of Mines station at Boulder City, Nev., is described in a Bureau report released recently by the Department of the Interior. The publication is the latest in a series of progress reports on the development of the Kroll process for producing this light, strong, and corrosion-resistant metal.

Since 1949, when the Bureau's first report on pilot-plant production of ductile titanium was issued, this metal has attained commercial significance. New techniques, which the publication describes in detail, have been developed. The 200-lb batches are twice the size of the ones made three years ago, and even those were vastly greater than the tiny batches of only a few grams that were turned out when the Bureau began developing the Kroll process at the Salt Lake City, Utah, station in 1942.

The basis of the Kroll process, first reported by Wilhelm Kroll in 1940, is the reduction of titanium tetrachloride with magnesium in an inert atmosphere—the Bureau now uses helium to provide this. After consideration of various known methods of producing the metal, this process was chosen as the most promising for development during the Bureau's early titanium studies, which began at the Tuscon, Ariz., station in 1938.

After having increased the batches of titanium metal produced from a few grams to 15 lb, and discovering that an unlined pot could be substituted for the molybdenum-lined vessel first used by Dr. Kroll, the Bureau transferred development of the process to Boulder City in 1944. There major emphasis was placed upon regular production of a ductile metal of uniform grade for use in other phases of the Bureau's titanium program and for providing samples to enable industry, educational institutions, and research organizations to study the properties and probable usefulness of the material. By 1949, titanium was being turned out in 100-lb batches, and such process improvements had been made as mechanical instead of chemical cleaning of the vessel in which the reaction takes place, and drawing off most of the magnesium chloride formed during the reaction as a molten liquid.

Doubling the size of the batch to 200 lb yields more metal in the same working period and per square foot of working space, the report notes, although the reduction in cost has been insignificant. The most important innovation described is a so-called dry room, with an artificially dried atmosphere, where the reaction mass, composed of titanium and magnesium mixed with magnesium chloride, can be turned out without absorbing too much moisture. Then the crude titanium chips can be purified by vacuum distillation. The dry room also permits using other cost-reducing and laborsaving techniques.

Details of all steps in the production of crude-titanium chips are given. Many precautions that must be taken to assure highly ductile metal are outlined. Information also is included on the number of man-hours required for producing crude-titanium metal chips.

A free copy of Report of Investigations 4879, "Recent Practice at the Bureau of Mines Boulder City, Nev., Titanium Plant, by H. Fuller, D. H. Baker, Jr., and F. S. Wartman, can be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa.

German Manganese Research

ATTEMPTS by German metallurgists to produce a synthetic manganese ore for their steel mills during World War II are described in a Bureau of Mines report released by Secretary of the Interior Oscar L. Chapman, The Bureau now is engaged in similar research for American industry.

Like the United States, Germany lacks adequate reserves of high-grade manganese ores and was unable to import enough for military needs during the war. Consequently, researchers intensified their efforts to treat domestic manganiferous iron ores to produce a substitute for high-grade manganese ore.

The Bureau's report, based on a translation of a paper by four German technologists, tells how high-manganese pig iron was produced from manganiferous iron ore and subsequently blown in a basic converter to make a high-manganese slag. This slag or synthetic ore then was treated further in a blast furnace in efforts to obtain ferromanganese for direct use in open-hearth steel production.

Translation of the German report was prepared by the Bureau and includes many tables showing results of the German experiments.

In co-operation with the American Iron and Steel Institute, the Bureau of Mines in Pittsburgh is engaged in an extensive research program aimed at developing a commercially adaptable process for obtaining manganese from open-hearth steel slag. The process being studied by the Bureau utilizes a blast furnace and basic converter in the operating cycle.

A free copy of Information Circular 7634, "Production of Manganese Slags From Manufacturing High-Grade Ferromanganese by Blowing Oxidation Spiegeleisen," can be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa.

Technical Institutes

A SUMMARY of the eighth Annual Survey of Technical Institutes, which was made during January, 1952, and prepared by Leo F. Smith, chairman, and Maryfrances Dudley, Educational Research Office, Rochester Institute of Technology, appears in the *Technical Education News*, June, 1952. All institutions were asked to give enrollments as of Jan. 2, 1952. The present survey includes enrollments for 64 schools, two less than the number reporting a year ago.

In the 64 institutes reporting, 19,631 regular day students were enrolled. This represents a decrease of 19.3 per cent as compared with 24,345 students in 1950-1951. In addition 26,786 evening and special students were reported this year, an increase of 21.2 per cent over the 22,096 reported last year. The grand total of 46,417 reported this year is a decrease of only 0.05 per cent as compared with 46,441 reported in 1950-1951. Enrollment in the Canadian schools is not included in these comparisons.

MARITIME ACADEMIES AND FEDERAL SCHOOLS

The report lists 375 students as the regular day enrollment in the state maritime academies and federal schools as compared with 327 in the same two schools a year ago.

Captain Arthur J. Spring, director of the U.S. Maritime

Service Institute, reports, in addition, that 8609 students are actively enrolled in correspondence courses. This is the highest activity of the school in its eight years of existence. In 1951 a total of 1069 certificates of completion were awarded to students for courses they completed during the year.

The Maritime Service Training Stations at Alameda, Calif., and Brooklyn, N. Y., offered in 1951 a wide variety of courses ranging from one to eight weeks in length.

STATE AND MUNICIPAL INSTITUTES

An enrollment of 8085 regular day students is indicated in the 18 institutes reporting, as compared with 8167 in 16 such schools last year. Of particular interest is the large increase in evening and special students—a total of 8070 this year as compared with 4696 a year ago.

This year for the first time the two new state institutes at Manchester, and Portsmouth, N. H., are included in the survey.

PRIVATELY ENDOWED INSTITUTES

An enrollment of 2594 regular day students is listed in ten privately endowed institutes, compared with 3434 reported by nine schools one year ago.

Ohio Mechanics Institute reports several new evening courses with a marked increase in enrollment over one year ago.

EXTENSION DIVISIONS OF COLLEGES AND UNIVERSITES

A regular day enrollment of 2121 is reported in the extension divisions of six colleges and universities reporting as compared with 2306 reported by five institutions last year.

New York University reports a wide variety of courses in the field of graphic arts, which are being received with considerable interest. A total of 817 individuals are enrolled in part-time courses in this varied program.

Southern Technical Institute reports special courses in basic electronics for the U. S. Air Force and for Lockheed Aviation Corporation's local plant.

PROPRIETARY TECHNICAL INSTITUTES

There was a regular day enrollment of 6325 in the 20 schools reporting, as compared with 9864 reported by 23 schools a year ago.

The Milwaukee School of Engineering has a $625,000 fiftieth-anniversary development program under way. New courses in mechanical service, mechanical technology, and mechanical engineering are being offered.

YMCA SCHOOLS

The YMCA Technical School of Seattle, Wash., was the only YMCA school reporting day enrollment this year. This school reported 131 students this year as compared with 128 enrolled a year ago. Last year three schools reported a total of 247 day students.

CANADIAN SCHOOLS

The enrollment for the six Canadian schools that reported shows a regular day enrollment of 2126 this year compared with 2215 reported by seven schools one year ago.

The Ryerson Institute of Technology has new broadcasting studios with extensive TV facilities for their varied work in television.

SUMMARY AND CONCLUSIONS

The survey brought out the following generalizations:

1 Enrollments in the day programs are down markedly (19.3 per cent) as compared with one year ago, although the enrollment of evening and special students is up 21.2 per cent. The total enrollment has decreased only 0.05 per cent.

2 Once again new building programs are reported and several of the institutes are taking active steps to improve their facilities.

The New York State Institute of Applied Arts and Sciences at Brooklyn reports the largest day enrollment with 2218 students, but the Rochester Institute of Technology has the largest evening program with 3395 students. Brooklyn has the largest total enrollment with 4920 students compared with a total enrollment of 4289 at RIT.

Oil Industry

THE American oil industry is spending more money this year than in any other one-year period in history, to assure the American people and national security a continuing supply of petroleum products.

This was announced by Frank M. Porter, president of the American Petroleum Institute, New York, N.Y. He reported that a survey indicates that capital expenditures scheduled for 1952 will exceed $4 billion.

The API president pointed out that this estimated expenditure boosts the industry's total for the seven postwar years to more than $19 billion.

This, he said, is probably the greatest expenditure of all time by any single industry for expansion and development over so short a period.

The 1952 total represents an increase of 25 per cent over last year's peak of $3270 million, Mr. Porter said. He expressed belief that the total is on the low side because the survey includes only a conservative estimate for the thousands of independent operators on whom no actual information is available.

These billions are being poured into new oil wells, refineries, pipe lines, tankers, and other transportation facilities, fertilizer and chemical plants, distribution outlets, and many other new, modernized, or expanded operations. This will, of course, require a continuing flow of vast supplies of steel and other materials, the API president added.

The American people are the most prolific users of petroleum in the world, and consumption in the postwar years has been skyrocketing. It is now 43 per cent higher than it was in 1946 and 73 per cent higher than 1941. Motor vehicles alone are consuming about 44 billion gal of gasoline a year, and home oil burners are accounting for more than 10 billion gal of fuel oil. It is to meet these increasing demands of today, and the projected increases of tomorrow, for peace or war, that the oil companies are carrying out their continuing program of expansion and development.

The survey made by the Institute shows that impressive increases are indicated in both the production and refining phases of the business.

Oil companies have earmarked more than $1\frac{1}{2}$ billion for wells and equipment this year. This is an increase of more than $200 million over last year and reflects the industry's response to the government's request for a stepped-up drilling program. This program calls for 55,000 new wells in 1952—an increase of 10,000 over last year.

Expenditures to build new refineries, construct new units, and modernize existing facilities in this country are estimated at $566 million for 1952. This total will top last year's by $263 million.

Other important building plans are indicated in the funds allotted for tanker construction. For example, more than $104 million will be spent for this purpose in 1952, which is nearly four times larger than last year.

Nearly $289 million will be spent for marketing purposes—up 8 per cent over 1951.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Production Engineering

The Significance of the Thermal Number in Metal Machining, by B. T. Chao and K. J. Trigger, Mem. ASME, University of Illinois, Urbana, Ill. 1952 ASME Semi-Annual Meeting paper No. 52—SA-58 (mimeographed).

THE theoretical analysis of heat flow in conjunction with cutting data in high-speed orthogonal metal-machining operations reveals that, for a given tool rake, the temperature distribution along the shear plane is solely dependent on the thermal number $V_s t/k$.

Under usual cutting conditions a larger thermal number results in a more uniform temperature distribution along the shear plane.

Within the range investigated the effect of cutting speed and feed on chip-thickness ratio, shear strain, shear angle, and specific energy of metal removal can be expressed in terms of the thermal number (constant rake angle).

The tool-chip interface temperaure is not solely dependent upon the thermal number.

Since an increase in speed and/or feed reduces the specific energy requirements in metal removal and at the same time increases the tool-chip interface temperature, the ultimate economy in a metal-cutting process is dictated by a compromise of these opposing factors.

New Developments in Cutting Metal, by R. J. S. Pigott, Fellow and President ASME, Gulf Research and Development Company, Pittsburgh, Pa. 1952 ASME Semi-Annual Meeting paper No. 52—SA-55 (mimeographed).

IN the course of improving the consistency of test results with various cutting fluids, it has been found that most of the factors affecting tool life have not been reasonably well controlled and large variation in repeat tests has been usual.

Experience showed that variation in machinability at constant cutting speed, with normalizing only, can affect tool life as much as 5:1—sometimes more. By careful heat-treatment, this can be greatly reduced to perhaps 1.8:1 max/min. Steel for test is, in so far as possible, obtained in 15 or 25-ton lots from a single heat.

The author's method of tool grinding holds angles to 0°1′, and surface finish to 6–8 microinches. Tools are made from bars provided by single heats, in large lots. Magnafluxing shows no surface cracks, and no handwork whatever is done on the tools.

The machines used for test are 16-in. lathes, either new or fully overhauled. The deflection under load has been checked—these deflections will of course differ for different machines. A two-bearing live center is used in the tailstock. Work has been done largely on SAE 1020, 1045, 3140, and 4140, normalized and annealed, at 110 and 140 sfm, tool 10-12-8-10-6-6$^3/_{64}$, with a cut 0.150 in. deep, feed 0.011 ipr. Surface speed is held within ±1 per cent, checked twice each pass. The bars are 9 in. diam, 32 in. long, and are cut to 2 in. diam. Below this diameter deflection is too great.

The cutting fluid is held to ±5 F by external heaters and coolers and operations are based on 100 F oil-tank temperature.

After investigating special tool shapes recommended to shorten tests, and increased speeds over normal, it was decided to use standard tool shapes and speeds recommended for the material and the cut in the ASTE handbook. However, the difficulty in obtaining steel for this purpose and the large increases in tool life possible with the new method of applying cutting fluid have forced the use of higher speeds than normal for much of the testing and a reduced depth of cut. These tests are periodically checked against normal speed tests since the difference in tool life between the high-speed jet operation and the conventional system is usually much more pronounced as cutting speed is increased. Since the nose of the tool is the best-protected part of the cutting edge, changes of cut depth have no appreciable effect on tool life—quite the opposite of the results with the conventional system.

A description of the new method of cutting-tool jet lubrication appeared in MECHANICAL ENGINEERING, February, 1952, pages 148-149.

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Management

Stretching Engineering Skill With Predetermined Time Standards, by Serge A. Birn, Mem. ASME, Serge A. Birn Company, Louisville, Ky. 1952 ASME Semi-Annual Meeting paper No. 52—SA-60 (mimeographed).

THIS paper is based on two and a half years' experience in the application of predetermined time standards—in a wide variety of industries, in this country and and abroad (France, Belgium, Switzerland, Holland). Although conditions vary greatly from country to country, the same general picture emerges, from observations here and in Europe. The greatest value of predetermined time standards in a dynamic industrial society —when engineering manpower is scarce— is that it allows industry to come much closer to the ideal solution of industrial problems, in advance of production. This saves valuable engineering and executive time.

Predetermined time standards are too often looked upon just as a more refined work-measurement tool. This is not so, the paper points out. Work measurement is not their most important use. In times of engineering-manpower scarcity—in a dynamic industrial society —their greatest value lies in allowing industry to come much closer to the ideal solution of problems in advance of production. This applies to plant layout, product, jig and fixture design, balancing assembly lines, packaging, cost estimating, etc.—from a blueprint, lab model, or just a sketch. Costly development errors are avoided, reducing to a minimum time losses for corrective action. This may apply to grievances, to rearranging conveyer work stations, to reworking fixtures, and so on. The greatest timesaving is intangible—it lies in the quality of engineering. It is less important that with predetermined time values industrial problems are solved faster—they are solved better.

Fuels

Proper Design, Installation, and Application of Coal-Burning Equipment for Boilers (25–500 Hp) to Prevent Smoke and Air Pollution, by H. C. Ballman, Mem. ASME, Smoke Regulation Engineer, City of Columbus, Ohio. 1952 ASME Semi-Annual Meeting paper No. 52—SA-44 (mimeographed).

WITH the advent of the smoke regulations authorized by ordinance in many cities, it has been found that a good measure of control in the installation of coal-fired equipment has been possible, provided the rules and regulations pertaining to installations have been based upon nationally accepted standards of good practice. It has been shown that smoke-regulation engineers have performed outstanding services to equipment interests. The value of this service has been in inverse ratio to the amount of direct supervision the equipment company employed in the final installation of their equipment. In the case of large equipment, companies normally furnish their own engineering, installation, and erection service, and the one company is solely responsible. With the smaller units of equipment direct control of the equipment company over its installation becomes less and less until the condition of least control is reached on the smallest heating devices.

For many years, equipment people, particularly in the medium-to-smaller sizes, have tried to correlate the installation of their equipment with their recommended practices, but unfortunately have accomplished little because in nearly all cases they have had to sacrifice their ideals for competitive reasons. These are the cases where the smoke-regulation engineers have performed a valuable service, insisting that the manufacturer's recommended practice is adhered to in the field.

One reason for lack of correlation of installation procedures with the manufacturer's recommended practices may lie in the fact that the total installation expenditure is too low to warrant supervisory or consultant services.

Another reason for the lack of correlating installation procedures with manufacturer's recommendations may be the agent handling the job.

Also when the sales division of an equipment firm is predominant in the policies of a given company, the promises become more aggressive; and in contrast, when the engineering division of an equipment company controls its policy, the more conservative are its claims.

From the foregoing it is concluded that more satisfactory installations will result:

1 When ways and means are provided to sustain, by fees, qualified engineering services on all installations of equipment from 25 to 500 hp.

2 When physical limitations of equipment are given greater evaluation in relation to utilization of installation, than sales argument.

Some examples of efforts made in the City of Columbus to obtain good installations of coal-burning equipment are illustrated in an appendix. From the examples given it may be noted that three items are not properly determined prior to installation. These are (1) load determination, (2) operator deficiency, and (3) tabulated or recorded performance data on other similar installations.

Flame Velocities in Carbon Monoxide-Oxygen Mixtures, by T. W. Price and J. H. Potter, Mem. ASME, University of Illinois, Urbana, Ill. 1952 ASME Semi-Annual Meeting paper No. 52—SA-65 (mimeographed; to be published in Trans. ASME).

ONE of the ideal theoretical devices for determining flame velocities is the constant-pressure adiabatic bomb. In practice this has been realized in the form of a soap bubble filled with a premixed gas-oxidant combination, centrally ignited by a spark, and observed by high-speed photography. However, the aqueous soap film imposed certain restrictions, in that moisture content was not controllable, and that the film itself might have taken some part in the combustion reaction.

This paper reports on (*a*) a search for a substitute material for the bomb, and (*b*) the development of a technique in which a very thin, transparent, rubber balloon was used.

The new method was then used to determine flame velocities in carbon monoxide-oxygen mixtures saturated with water vapor. These velocities were found to increase with increase of initial mixture temperature.

Properties of Coal—Their Influence on Performance of Coal-Burning Apparatus, by B. E. Tate, Mem. ASME, National Cash Register Company, Dayton, Ohio. 1952 ASME Semi-Annual Meeting paper No. 52—SA-54 (mimeographed).

TOO often coal is sold and bought on the basis of cost per million Btu delivered in the bunkers. This very important item is not disregarded in this discussion but, rather, full recognition is given that coal cost is but one of a number of very important properties which must be jointly considered in the selection of coal for industrial use.

Premium payments of 15 or 20 per cent, amounting to more than a dollar per ton of coal are quite common, and are quite necessary in many boiler plants to obtain the lowest operating cost. How long that condition should continue to exist is another question but that it does exist in a great many boiler plants is indisputable.

The other properties to be considered include: Size consist (including uniformity of size consist), swelling prop-

erty, grindability, moisture content, ash content, ash-fusing temperature, and sulphur content.

Savings in operating cost are not the only benefits to be derived in giving proper consideration to these other properties of coals. Many operating difficulties for both the boiler plant and the factor as a whole may be avoided by giving proper consideration to them, and such consideration may lead to a better standing in the neighborhood. During the past decade industrialization of the towns and cities in the United States has made great progress. But the public has been subjected to increased air-pollution nuisances with the result that stringent air-pollution ordinances have been put into operation in many of the cities. Proper consideration of all the properties of coals can do a great amount of good in reducing air contamination and will often permit the boiler plant to meet ordinance requirements without costly capital expenditures.

During the writing of this paper the author visited three boiler plants using specially prepared coals bought at premium prices for the purpose of satisfying neighborhood complaints of fly ash. One has a spreader stoker, one has an underfeed stoker, and the other has traveling-grate stokers. Two of them were facing lawsuits for the nuisances made prior to using premium coals. All were satisfiyng their neighborhoods with their special coals.

Preventing Air Pollution From Coal Fired Steam Generators, by Carl E. Miller, Mem. ASME, Combustion Engineering-Superheater, Inc., New York, N. Y. 1952 ASME Semi-Annual Meeting paper No. **52—SA-68** (mimeographed).

THIS paper concerns the prevention of air pollution from coal-fired steam generators ranging in capacity from 10,000 to 50,000 lb of steam per hr. As an equipment manufacturer, two general questions are of basic importance:

1 What types of coal-burning equipment are involved and what are their characteristics?

2 What other groups have a cooperative interest in the problem?

Two points seem to stand out, as the result of this discussion:

1 As an equipment manufacturer, a major responsibility is to furnish a steam generator that is a completely coordinated design with particular reference to the stoker, furnace, and boiler to assure best performance from all aspects including minimized air pollution. An additional responsibility is to have available an adequate service organization to assist the user in maintaining and operating his steam-generating equipment at its best, throughout its entire life.

2 Reduction in air pollution from smoke and fly ash is dependent on proper design and operation. Best results can be attained through the close co-operation of the user, the smoke-abatement officer, the coal producer, the consulting engineer, and the equipment manufacturer. It can hardly be overemphasized that this cannot be a one-man effort, but that the desired goal can be attained only by all interests working as a team in the harmony that is so typical of engineering groups.

Cooling Towers

Cooling-Tower Characteristics as Determined by the Unit-Volume Coefficient, by Donald R. Baker, Mem. ASME, and Leon T. Mart, Mem. ASME, The Marley Company, Inc., Kansas City, Mo. 1952 ASME Semi-Annual Meeting paper No. **52—SA-59** (mimeographed).

VARIOUS methods of analyzing cooling-tower performance have been developed. They are all rather closely related, and the Unit-Volume Coefficient that is presented in this paper is an adaptation of the transfer unit. It offers a means of determining the fraction of a transfer unit represented by one cubic foot (or unit-volume) of tower. The result is that integration is accomplished by increments of equal volumes. This makes it possible to analyze both cross-flow and counterflow towers. Examples are given showing the integration and also to show how various factors influence the performance of a cooling tower.

The results of laboratory and field test data substantiate the validity of the Unit-Volume Coefficient method of cooling-tower analysis. Considering the magnitude of the experimental errors as well as the difficulties encountered in obtaining accurate test data, the accuracy of the method is higher than anticipated. The use of the method has made it possible to (1) Refine testing technique; (2) test experimental filling in small-scale test models, and predict the performance in full-scale towers; (3) predict performance ratings of proposed towers while still in the design state; and (4) study the effect of outside influences on cooling-tower performance. These include recirculation, effect of wind velocity and direction, and the interference from surrounding structures.

Regardless of the validity of the theoretical basis for any method of cooling-tower analysis, its application is purely a matter of empirical correlation. The Unit-Volume Coefficient has proved to be quite easy to correlate with experimental data. Its sensitivity and accuracy make it possible to study fundamental relationships.

Petroleum

Infrared Carbon-Monoxide Gas Analyzer —A Tool for Afterburning Prevention, by J. L. Serrill, Jr., Leeds and Northrup Company, Philadelphia, Pa. 1952 ASME Semi-Annual Meeting paper No. **52—SA-69** (mimeographed).

FLUID catalytic-cracking units are an integral part of most refineries' processing equipment. Refinery process engineers have been faced with the problem of increasing catalytic-cracking production with existing facilities. In accomplishing this objective, one of the more common problems encountered is the raising of the carbon-burning rate of the regenerator without getting "afterburning" and reduced catalyst or equipment life.

One of the most satisfactory solutions to this problem has stemmed from the use of an infrared-type carbon-monoxide analyzer. Engineering investigation on a large catalytic-cracking unit showed that afterburning could occur in the regenerator under a variety of operating conditions and while oxygen or temperature measurements would eventually show an afterburning condition, the afterburn would be so well established that drastic measures would have to be taken to bring it under control. These measures almost invariably reduced production as well as the activity of a portion of the catalyst because of its being subjected to excessively high temperatures. However, with the infrared CO analyzer the starting phase of an "afterburn" could be immediately detected and corrective measures could be taken to keep the afterburn under control without affecting production.

In addition to afterburn prevention, several other benefits from the use of the CO analyzer were realized. The conversion rate and carbon-burning rate were appreciably increased and handling of the unit during start-ups, shutdowns, and stand-by operation was made very much easier.

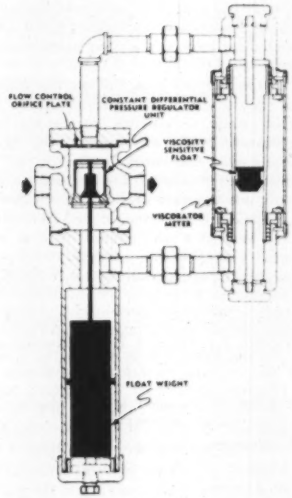
The infrared CO analyzer is particularly suited to this application because of its high sensitivity and very high speed of response. Furthermore, this type of analyzer is very specific in the measurement of carbon monoxide regardless of the other constituents in the gas stream.

The analyzer is simple, rugged, reliable and the maintenance required is small, being handled entirely by regular instrument men.

Continuous Viscosimetry, by R. W. Fritzsche, Fischer & Porter Company, Hatboro, Pa. 1952 ASME Semi-Annual Meeting paper No. 52—SA-67 (mimeographed).

VISCOSITY measurement need not be a costly time-consuming laboratory operation in modern production. The process or instruments engineer has access to a reasonable selection of viscosity-sensitive instruments and can therefore design an automatic control system in which viscosity is the primary variable. The success of his effort will depend largely upon proper classification of the requirements; selection of a suitable principle of viscosity measurement with respect to inherent or externally-imposed time lag, sensitivity, and accuracy, and the degree of refinement attending complementary heat-exchange apparatus or temperature-control instrumentation.

Continuous viscosimeters at the present stage of development are reliable for: fully automatic operation of vacuum distillation units in the lube-oil plant where improved fractionation and product uniformity provide the justification; for continuous blending of fuel oils and cutback asphalts on road oils where the payout appears in reduced storage capacity for blended materials; for tender identification in crude-oil pipe-line service where instantaneous interface detection can reduce contamination or diversion to slop tanks; for controlling viscosity of bunker fuels directly instead of by use of the conventional temperature controller, which, regardless of viscosity, delivers steam at the rate required for the most extreme conditions; and for many other processing requirements.



FLOAT-TYPE VISCOSIMETER WITH FLOW REGULATOR

The Stresses in a Pressure Vessel With a Hemispherical Head, by G. W. Watts, Fellow ASME, and H. A. Lang, Mem. ASME, Standard Oil Company (Indiana), Chicago, Ill. 1952 ASME Semi-Annual Meeting paper No. 52—SA-19 (in type; to be published in Trans. ASME).

THIS paper, the third of a series, presents the results of computations for determining the stresses in a pressure vessel with a hemispherical head. The bending theory of shells is used to evaluate the maximum stress at the junction between head and shell. Tables show the magnitudes of the shear stress, the axial stress, and the circumferential stress at the junction as multiples of $pd/2t$. The axial and circumferential stress have been computed for both surfaces. Additional results show the magnitude, sense, and location of the maximum stress (of each of the three types) in the shell. The largest value of the diameter-thickness ratio of the head for which computations were made is 40. When the diameter-thickness ratio of the head exceeds 40, well-known approximate theories can be used. The limit of 40 is imposed by the slow convergence of the hypergeometric series. Tables of influence numbers for both the head and shell are included for application to other problems. A brief discussion of the mathematical procedure is included.

Gas-Turbines

Performance of a Cascade Designed for Prescribed Loading, by David C. Prince, Jr., General Electric Company, Lynn, Mass. 1952 ASME Semi-Annual Meeting paper No. 52—SA-40 (mimeographed).

IN the design of axial-flow compressors some means is needed for designing blade profiles with assurance that the blades will produce in a real fluid the energy input and pressure rise required for the design. The problem becomes more difficult as the desired energy input increases. One possible way to satisfy this need is to rely on potential flow design methods, and to correlate the performance in real fluids and in ideal fluids by cascade wind-tunnel tests.

This paper presents the results of such a correlation. The cascade was designed by conformal transformation methods to have an approximately flat pressure distribution on the suction surface and a blade loading somewhat higher than is used in current design practice. The performance characteristics in a real fluid were evaluated in the Low Speed Cascade Wind Tunnel of the M.I.T. Gas Turbine laboratory.

The results of this investigation showed that under favorable conditions the real fluid flow can approach the potential flow very closely. In this case it was necessary to avoid low free-stream turbulence levels which caused separation of the laminar boundary layer. It seems unlikely that low turbulence levels should be a problem in axial-flow compressors, where each blade row is normally subjected to a fluctuating flow from the wakes of the blades in the preceding row passing in rapid succession.

Railroads

Developments in Rubber Draft Gears, by A. M. Bixby, Mem. ASME, Waugh Equipment Company, New York, N. Y. 1952 ASME Semi-Annual Meeting paper No. 52—SA-56 (mimeographed).

THE data presented in this paper indicates that rubber may be successfully used as a draft-gear medium, and that it will perform uniformly over at least a decade of service. Twin-cushions will protect freight-car structure and lading under extreme operating conditions, and contribute to improved riding of passenger equipment. The development of Rubber Draft Gears from the light railroad equipment in England and Europe has now progressed to modern American passenger cars and heaviest freight equipment. With full acceptance by the A.A.R. for freight equipment, additional progress will be made in this field, which will be a substantial contribution to the American railroad industry.

Developments in Cushioned Underframes, by William K. Durbon, Hulson Company, Chicago, Ill. 1952 ASME Semi-Annual Meeting paper No. 52—SA-66 (mimeographed).

THE subject, "Developments in Cushioned Underframes," implies several different meanings: (1) There have been improvements in the details of cushioned underframe cars; (2) the functional aspect has been improved; and (3) the developments are of major importance when the mechanical implications of the effect of impact on

freight operations loss and damage are considered.

The fundamentals of such installations and relative merits are not new and are briefly as follows: Train slack and cushioning travel are independent, train slack is determined by movement of coupler, cushion gear travel is determined by movement of center column, reduced coupler movement is advantageous in handling all trains because slack action is minimized, and long cushion gear travel is advantageous in switching as cushioning capacity can be increased without a corresponding rise in coupler forces.

On most of the cushioned underframe cars now in service, coupler movement is set at $^3/_4$ in. while cushion gear or sill travel is 7 in. except for caboose cars which is $10^1/_2$ in.

Up until now, conventional members such as channel or Z-bar sills have been used in all cushioned underframe car construction in combinations with helical springs, rubber, etc., Although far in advance of conventional devices, capacities limit them to fully cushioned coupling speeds of less than 7 mph.

During the past year, studies indicate that capacities of 200,000 ft-lb or more—required to provide a margin of safety above the 7-mph limit—are not only reasonable but mechanically feasible.

Steam Power Generation

Material-Handling Facilities at Walter C. Beckjord Station, by R. F. Schierland, The Cincinnati Gas & Electric Company, Cincinnati, Ohio. 1952 ASME Semi-Annual Meeting paper No. 52—SA-62 (mimeographed).

WALTER C. Beckjord Station of The Cincinnati Gas & Electric Company, located on the Ohio River near New Richmond, Ohio, is not situated on a railroad. This paper describes the river crane and barge equipment used to bring heavy equipment to the station site.

The Company's Miami Fort Station, located 20 river miles downstream from Cincinnati, and 38 river miles from Walter C. Beckjord Station, is provided with a spur from the Baltimore & Ohio R.R., and was chosen as the railhead for the Walter C. Beckjord Station rail-river shipping system. Ample land was available adjoining the river for the barge loading-crane structure, track approach, and barge anchorages.

The original design of the cranes was 125 tons, with a 50 per cent overload rating, for a gross capacity of 187.5 tons. Subsequent minor revisions in design have raised the capacity to a maximum of 207 tons. To avoid unduly expensive cantilever structures, the design provides that this maximum load can be carried only to the longitudinal centerlines of barges on the river ends of both cranes, and to the centerline of the transfer track on the land end of the Walter C. Beckjord Station crane. With lesser loads, greater reaches are allowed.

In the general arrangement of the Walter C. Beckjord Station crane, a railroad track runs under the land end cantilever section, perpendicular to the longitudinal axis of the bridge. South of the crane, the track has two branches. The east branch runs by the main power transformer positions. A special transformer transfer car is provided for handling this equipment. The west branch runs into the station turbine room unloading bay, where loads are handled by the turbine room crane. The turbine room crane, of the usual overhead traveling type, is nominally rated at 150-ton on the main hook, but is suitable for carrying the same maximum loads as the river cranes.

Loads are carried from the river crane to the turbine-room unloading bay on a special steel deck car capable of carrying the maximum load which can be handled by the cranes. The car is moved with a four-wheeled, rubber-tired, Diesel-engine tractor provided with a car coupler. The tractor is part of the station's complement of coal-moving equipment, and normally draws a two-wheeled scraper. When it is to be used for car moving, the scraper is removed by use of an overhead crane in the tractor garage, and a cast-iron ballast weight is installed to provide adequate traction.

While the bridge structures of the Beckjord and Miami Fort cranes differ greatly, the trolleys are identical. The 207-ton hook on each crane has a maximum speed of 4 fpm. An auxiliary hook is also provided, of a maximum capacity of 37.5 tons (25 tons nominal with 50 per cent overload rating) and a maximum speed of 27 fpm.

A floating dock is used for handling coal barges at both Walter C. Beckjord Station and Miami Fort Station. In designing the new dock for the former station, and a replacement dock for old equipment at the latter, each was made 330 ft long; each dock consists of three compartmented steel flat-top barges 110 ft long × 26 ft wide. With only minor inconvenience, a 220-ft length is satisfactory for the docks. The down-river end barge at each station, therefore, was designed as a cargo barge provided with special deck construction to take the concentrated load of a generator stator.

Towing of The Cincinnati Gas & Electric Company barges is done under contract with one of the towboat operators regularly plying the Ohio River.

Special Features at Milesburg Power Station, by W. V. Drake, Mem. ASME, and R. A. Mycoff, Jun. ASME, West Penn Power Company, Milesburg, Pa. 1952 ASME Semi-Annual Meeting paper No. 52—SA-63 (mimeographed).

WEST Penn Power Company, like many others in the electric-power industry, have continually endeavored to keep power rates low even in the face of increasing costs. More efficient designs and lower-cost operating features have been a major factor in this battle to keep costs under control.

In 1949 the company was faced with the need of additional generating capacity in Pennsylvania's Centre County. This area is somewhat isolated from the main system, having only one transmission line of approximately 105 miles connecting it to the principal transmission network. Studies indicated that a two-unit station of approximately 45,000 kw was required to supply a dependable source of energy to this area. Financing and building a station with comparatively low-output units at an acceptable cost per kilowatt was not only a problem but a necessity. This goal has been accomplished since the plant was built at an approximate cost of $160 per net kw including land and step-up tranformers with breakers.

To accomplish this, full use was made of the site which has a ground formation that made it possible to practically eliminate costly excavations, the deaerator was eliminated by the use of a deaerating condenser, the distilled water tank was mounted at ground level, spare equipment was minimized, and the plant was built as a semioutdoor plant in an area where outside temperatures drop to zero and occasionally lower.

Design for Extreme Flood Conditions at the Paddy's Run Station, by D. C. Hormell, Mem. ASME, Pioneer Service & Engineering Company, Chicago, Ill. 1952 ASME Semi-Annual Meeting paper No. 52—SA-61 (mimeographed).

WHILE many power plants have been designed and built in areas subject to flood waters, few, if any, have the great variation of river elevation that prevails at the Paddy's Run Station, 83 ft

from low river to extreme flood. Other engineers, or other designers, may have selected a different solution for the problems encountered here and still have a functionally well-designed plant with good operating conditions and good efficiencies.

Since there was little or no precedent in the power industry to guide in the selection of equipment on the basis of past performance, it is logical to ask, isn't such special equipment costly? The answer is yes. The first cost is greater than for more conventional types. However, the special conditions exist and the decision as to where to locate or transfer such conditions to best advantage becomes a question of economics and local restrictions. Detailed studies of several possible layouts indicated that the design and arrangement finally selected for the Paddy's Run Station resulted in savings in fixed charges which were greater than the increase in operating expense. Approximately ten years' reliable performance and comparatively trouble-free operation at relatively low cost have justified management's acceptance of the basic design, and their approval of similar equipment of greater capacity for the later installations at this station.

Applied Mechanics

Bending With Axial Force of Curved Bars in Plasticity, by Aris Phillips, Stanford University, Stanford, Calif. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-9** (in type; to be published in the *Journal of Applied Mechanics*).

THE problem of symmetrical pure bending with axial force of a curved bar in plasticity is considered. A method is given for finding the axial load and bending moment which produce a given strain distribution. This method is based upon approximating the stress-strain curves by means of broken lines. By increasing the number of sides of these broken lines it is possible to solve our problem with high accuracy.

Correlation of Creep Properties by a Diffusion Analogy, by Leon Green, Jr., Jun. ASME, North American Aviation, Inc., Downey, Calif. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-22** (in type; to be published in the *Journal of Applied Mechanics*).

THE necessity of atom movements for both creep and self-diffusion suggests a method of correlating the constant-stress creep properties of pure metals. The concept of steady-state creep is discarded, and two empirical approximations for the strain-time behavior of pure polycrystalline metals lead to a creep equation defining an activation energy as the only undetermined constant. For cases where the orientation of individual crystals is important, a second constant is required. Application of this equation to published creep data effects a correlation which indicates that the apparent activation energies observed for creep and self-diffusion show a similar temperature dependence. The effect of stress upon the activation energy for several metals is described approximately, but the need for further experiments encompassing lower values of stress is revealed. The qualitative effects of impurities, grain size, cold-working, and surface conditions upon creep as predicted by a diffusion analogy are found in agreement with experimental results, but the analogy does not hold if creep deformation is obtained as a result of slip.

Plastic Flow in a V-Notched Bar Pulled in Tension, by E. H. Lee, Mem. ASME, Brown University, Providence, R. I. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-4** (in type; to be published in the *Journal of Applied Mechanics*).

A V-NOTCHED bar pulled in tension in plane strain is considered. The distribution of stress and deformation are determined from the analysis of the motion with large strains as the initial notch width pulls down toward line contact as the test proceeds. The analysis is based upon the theory of flow of a so-called Saint Venant-Mises material, which flows at a constant yield limit given by the Mises criterion, and obeys the Mises flow-type relationship between stress and strain increments. The successive configurations of an initially square grid on the cross section of the notch are obtained to illustrate the strain distribution. This solution is of interest in investigating the initiation of fracture in a notched-bar tension test. In such a test the foregoing type of solution applies until plastic flow is arrested by the appearance of a fracture crack. The variation of the solution with notch angle is of interest in connection with the determination of the technical cohesive strength of a metal using Kuntze's technique. The present solution indicates a contrast with Kuntze's hypothesis, in that it predicts the possibility of a plastic-flow type of rupture at a stress depending only upon the yield stress of the metal.

ASME Transactions for August, 1952

THE August, 1952, issue of the Transactions of the ASME (available at $1 per copy to ASME members, $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

How to Obtain Instrument Accuracy With Proportioning Pumps, by J. N. Swarr. (51—A-53)

Discharge Coefficients of Herschel-Type Venturi Tubes, by A. L. Jorissen. (51—A-56)

Nozzle Characteristics in High-Vacuum Flows—Rarefied-Gas Dynamics, by R. G. Folsom.

Basic Difficulties in Pulsating-Flow Metering, by A. R. Deschere.

Orifice and Flow Coefficients in Pulsating Flow, by N. A. Hall. (51—A-149)

Pulsations in Gas-Compressor Systems, by E. G. Chilton and L. R. Handley. (51—A-90)

Progress Report on the Study of Supercompressibility Factors for Natural Gases, by R. H. Zimmerman and S. R. Beitler. (51—A-153)

Heat Transfer and Fluid Friction During Flow Across Banks of Tubes—IV, by O. P. Bergelin, G. A. Brown, and S. C. Doberstein. (51—A-109)

Heat Transfer by Gas Conduction and Radiation in Fibrous Insulations, by J. D. Verschoor and Paul Greebler. (51—A-54)

A Method of Correlating Heat-Transfer Data for Surface-Boiling of Liquids, by W. M. Rohsenow. (51—A-110)

Heat Transfer and Pressure Drop for Turbulent Flow of Air-Water Mixtures in a Horizontal Pipe, by H. A. Johnson and A. H. Abou-Sabe. (51—A-111)

Runaway Speed of Kaplan Turbines, by G. H. Voaden. (51—A-100)

Contributions to Hydraulic Control:

1 Steady-State Axial Forces on Control-Valve Pistons, by Shih-Ying Lee and J. F. Blackburn. (51—A-52)

2 Transient-Flow Forces in Valve Instability, by Shih-Ying Lee and J. F. Blackburn. (51—A-60)

Tool Forces and Tool-Chip Adhesion in the Machining of Nodular Cast Iron, by K. J. Trigger, L. B. Zylstra, and B. T. Chao. (51—A-39)

A Comparison of Parameters for the Machining of Gray Cast Iron, by L. V. Colwell, H. J. Holmes, and F. B. Rote. (51—A-47)

Thermophysical Aspects of Metal Cutting, by B. T. Chao, K. J. Trigger, and L. B. Zylstra. (51—A-41)

The Mechanics of Three-Dimensional Cutting Operations, by M. C. Shaw, N. H. Cook, and P. A. Smith. (51—A-61)

The Rotary Cutting Tool, by M. C. Shaw, P. A. Smith, and N. H. Cook. (51—A-62)

Measuring the Cooling Properties of Cutting Fluids, by G. M. Hain. (51—A-40)

The Stresses in a Pressure Vessel With A Flat Head Closure, by G. W. Watts and H. A. Lang. (51—A-146)

Low-Temperature Separation for High-Pressure Gas - Distillate Wells, by C. O. Glasgow.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Engineers and Ivory Towers

ENGINEERS AND IVORY TOWERS. By Hardy Cross. Edited and arranged by R. C. Goodpasture. McGraw-Hill Book Company, Inc., New York, N. Y.; Toronto, Ont., Can.; London, England, 1952. Cloth, 5¼ × 8 in., vii and 141 pp., $3.

IT IS difficult to put into words the spirit which animates engineers and engineering. Simple definitions fail because they are so brief and generalized that they may have almost universal application. Long detailed statements of what engineers do and precise descriptions of their achievements are cold and unsatisfying substitutes for that combination of idealism and common sense which those who have long associations with engineers discover to be one of their most engaging characteristics.

Hardy Cross, himself and engineer and a teacher of engineering, is not only charged with this animating spirit of his profession, but he is able to write about engineering and education in a manner which communicates some of that spirit to his readers. In the little book under review, "Engineers and Ivory Towers," selections from the speeches and writings of Professor Cross have been assembled and edited by a former student, Robert C. Goodpasture. The book will richly repay any one who reads it, not only for the glimpse one gets of what engineers are like, or for the mixture of idealism and common sense which fills its pages, but for the high quality of the writing as well.

Hardy Cross's writing is filled with pithy sentences and epigrams, and the temptation to quote extensively is almost irresistible. "The purpose of engineering is service," he says in the opening paragraph. On standardization: "In engineering there is no attempt to standardize unless there is some reason for it." A sentence Browning might have written: "Men must not be deceived into giving to dust that is a little gilt more praise than gilt o'er dusted." On teaching and universities: "It is easier to teach rules than to train judgment." "A great university is a group of honest scholars." "The purpose of education must be service and not self-promotion." "A most disintegrating intellectual influence today is the ideal that all human activities can be mastered by the methods of the physical sciences." "A teacher's first job is to teach, not to write or to do conventional research or to make speeches or to run errands on academic or technical committees, but to teach." "Great buildings and expensive laboratories can never make a great university; great teachers do." "However, what may be lauded as an unprejudiced frame of mind, breadth of view, intellectual liberalism, is often the most arrant twaddle—anemic intellectual sponginess." "In general the problems of civil engineering are given to them by God Almighty. They are problems in nature. On the other hand, mechanical and electrical work has problems which man, to a certain extent, has created for himself."

These few morsels should be enough to indicate the solid and spicy fare that is to be found in Hardy Cross and his ivory towers.—G. A. S.

Applied Statistics

APPLIED STATISTICS, A Journal of the Royal Statistical Society. Edited by Leonard H. C. Tippett. Vol. 1, No. 1, March, 1952. Oliver and Boyd Ltd., London, England. $4 per annum.

REVIEWED BY YUDELL L. LUKE[1]

THE purpose of *Applied Statistics*, a new journal of the Royal Statistical Society, is well described in the prospectus and in the foreword to the first issue. It is to provide a medium devoted to practical statistical problems that arise in all fields of human endeavor. "Applied Statistics has been founded—to meet the needs of all workers concerned with statistics, who must handle and understand statistics as part of their tasks. Its aim is to present, simply and clearly, the statistical approach and its value, and to illustrate in original articles modern statistical methods in their everyday applications."

Recently B. Epstein reviewed an important volume in the field of statistics (see *Applied Mechanics Reviews*, vol. 4, Review No. 3447). He points out that though the material is classic, it is difficult to read, even for the professional statistician, let alone for the worker who lacks the training to follow the mathematical argument. "Results are given so abstractly and the treatment is so complicated that—many readers will simply give up in despair." The same criticism applies to many other contributions dealing with statistical questions. Yet if the ideas expounded were translated into simple language, they could be readily applied to the solution of everyday problems in industry, science, and the like. The aim of *Applied Statistics* is to bridge the gap between the erudition of the professional statistician and the practicing engineer, social scientist, and the like. From this point of view *Applied Statistics* should fill a great need.

Applied Statistics will be issued three times a year: March, June, and November. The first issue dated March, 1952, contains seven articles aptly illustrating the viewpoint of the editors. For example, "The Introduction of Statistical Methods of Industry," by B. P. Dudding, discusses the application of statistics to the problem of control of manufacturing processes. An exposition is given of control-chart technique. The article considers "practical points that arise in introducing this technique into a factory and describes the advantages that accrue from its applications." Another article, "A Statistical Approach to the Specification of Plastics," by C. Wainwright, is an exposition of the principles of quality control as applied to the plastics industry, culminating in the design of a standard specification. The basic principles apply to other products as well. The technique is applied to design a specification suitable for laminated sheets. The scope of the paper "The Accuracy of Systematic Sampling From Conveyor Belts," by G. H. Jowett, is ably covered by the author as "the sampling of coal and similar materials for testing pur-

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poses is described, and it is shown how the results of a trial set of observations may be used to calculate the accuracy of a given sampling scheme."

A worth-while feature of *Applied Statistics* is the Questions and Answers section. Readers are invited to send questions to the editor. He will have them answered by people competent to deal with the subjects raised.

Books Received in Library

AMERICAN UNIVERSITIES AND COLLEGES, Mary Irwin, editor. American Council on Education, Washington, D. C., sixth edition, 1952. Bound, 7 × 9¾ in., 1105 pp., $10. Including the latest information, this book is an authoritative guide to accredited institutions of higher learning in the United States and its territories. In Part 1 there are concise but comprehensive descriptions of various aspects of American higher education. Part 2 supplies pertinent information about some 900 accredited institutions, now arranged alphabetically under the separate states. Further data are given in appendixes including ROTC data for each institution.

CARBIDE CUTTING TOOLS. By Warren Baker and Joseph S. Kozacka. American Technical Society, Chicago, Ill., 1949. Bound, 5¾ × 8½ in., 416 pp., tables, illus., diagrams, $5.50. Containing a considerable amount of previously unpublished material, this work provides a comprehensive treatment of the design, manufacture, use, and maintenance of cutting tools utilizing carbide as the cutting edge. General aspects are dealt with first, followed by chapters on particular tool types, speeds and feeds, selection of carbides, and so on. The book is profusely illustrated and contains a considerable amount of tabular data.

DIESEL ENGINE CATALOG, volume 17, 1952. Rex W. Wadman, editor and publisher. Published and distributed by Diesel Engines, Inc., Los Angeles, California. Bound, 10½ × 13¾ in., 409 pp., illus., diagrams, charts, tables, $10. Presents detailed descriptions of American Diesel engines, equipment, and accessories. All types are covered, including two and four-cycle and dual fuel, for stationary, railroad locomotive, marine, and automotive use. A classified buyers' guide of engines and accessories is provided. As usual, the new edition has been revised to include new designs developed during the intervening twelve months.

ELEMENTARY HEAT POWER. By Harry L. Solberg, Orville C. Cromer, and Albert R. Spalding. John Wiley & Sons, Inc., New York, N. Y., second edition, 1952. Bound, 5¾ × 8½ in., 624 pp., tables, diagrams, illus., charts, $6.50. This text aims to develop an understanding of the functions, principles of construction, and actual performance of heat-power machinery as a preliminary to the study of engineering thermodynamics. Matter and energy, fuels, and combustion are first considered, followed by chapters on internal-combustion engines, fuel-burning equipment, and steam-generating and utilizing installations. Pumps, compressors, gas turbines, and refrigeration are also dealt with.

ENGINEERING THERMODYNAMICS. By Newton C. Ebaugh. D. Van Nostrand Company, Inc., New York, N. Y., second edition, 1952. Bound, 6 × 9½ in., 398 pp., tables, graphs, charts, diagrams, $5.75. A textbook covering the elementary essentials of the science of thermodynamics as it applies to modern industry. The several chapters treat fluid states, energy equations, gas and vapor properties and mixtures, vapor power, internal-combustion and refrigeration cycles, entropy, and gas compression. An appendix contains answers to chapter exercises, a group of steam tables, several Mollier charts, and a psychrometric chart.

FORGING AND FORMING METALS. By S. E. Rusinoff. American Technical Society, Chicago, Ill., 1952. Bound, 5¾ × 8½ in., 279 pp., tables, illus., diagrams, $3.95. In addition to describing the equipment and methods for impact forging, press forging, upset forging and extrusion, this text covers metal quality and selection, heat-treatment, cleaning and finishing of forgings, and inspection. Design of dies, tools, and forged parts is dealt with, and safety practices are outlined. There are also a glossary of terms and a chapter on standard practices and tolerances for impression die forgings.

FOUR-PLACE INFLUENCE LINE TABLES. For Moments, Shears and Reactions. By Gustav Griot. Translated, revised, and enlarged by Harold G. Lorsch. Frederick Ungar Publishing Company, New York, N. Y., 1952. Bound, 6¼ × 9½ in., 87 pp., tables, $3.75. These four-place influence line tables are usefully employed to reduce greatly the calculating work required for the analysis of continuous beams under dead and live loads. There is a detailed explanatory introduction with numerical examples.

HANDBOOK OF ENGINEERING FUNDAMENTALS. Ovid W. Eshbach, editor. John Wiley & Sons, Inc., New York, N. Y., second edition, 1952. Bound, 5½ × 8½ in., various paging, tables, charts, graphs, $10. This companion volume to the specialized handbooks of the "Wiley engineering handbook series" contains the fundamental laws, theories, and data which are basic to engineering practice. The revision consists of deletions, additions, and changes indicated by sixteen years' experience with the first edition, one significant aspect being the much greater emphasis on the use of the MKS system of units. The subject matter is essentially an extended summary of the principles of mathematics, physics, and chemistry, and commonly used mathematical tables, the properties and uses of materials, and the mechanics of solids and fluids. A discussion of engineering law is included.

MACRAE'S BLUE BOOK, fifty-ninth edition, 1952. MacRae's Blue Book Company, Chicago, Ill. Bound, 8½ × 11¼ in., 4318 pp., illus., $15. Revised annually, this book is one of the most useful listings of manufacturers and materials of all kinds. It has four sections: address and local distributors' section, classified materials section, chemical section, and trade-name section.

MECHANICS AND PROPERTIES OF MATTER. By Reginald J. Stephenson. John Wiley & Sons, Inc., New York, N. Y., 1952. Bound, 6 × 9¼ in., 371 pp., charts, graphs, tables, $6. This text stresses the physical concepts involved in mechanics while presenting as well the mathematical procedures involved. The importance of these concepts in the whole field of physics is demonstrated. Vectors and simplified vector analysis are used throughout the book to familiarize the student with their use. Illustrative problems occur in the text and practice problems accompany each chapter.

PERSONNEL ADMINISTRATION. By William W. Waite. Ronald Press Company, New York, N. Y., 1952. Bound, 6¼ × 9¼ in., 683 pp., tables, illus., charts, $7. A restatement of the fundamental philosophies of personnel administration as they have evolved, demonstrating their application to current practical administrative methods and techniques. The problems of administration are discussed from the initial assembling of a work force through its efficient maintenance and interrelations with the staff. Extensive reading lists and selected questions for discussion are provided.

THE PHOTOGRAPHIC STUDY OF RAPID EVENTS. By W. Deryck Chesterman. Oxford University Press, New York, N. Y., 1951. Bound, 5½ × 8¾ in., 167 pp. + 32 pp., illus., diagrams, tables, charts, $5. This monograph deals with various techniques which may be employed and discusses the conditions of speed, lighting, repetition, and sensitivity which influence their choice. In addition to describing the equipment and characteristics of these techniques the author also gives an account of some of the problems to which they have been applied, such as joint movements, high-speed machine tools, airflow past projectiles, and the detonation of explosives.

PHYSIKALISCHES WORTERBUCH. By Wilhelm H. Westphal. Springer-Verlag, Berlin, Germany, 1952. Two volumes in one. Bound, 7½ × 11 in., 833 pp., 795 pp., illus., tables, graphs, charts, diagrams, 148 Dm. This highly useful reference work provides an encyclopedic treatment of the field of physics for the physicist who wants information outside his specialty and also for the engineer, metallurgist, chemist, biologist, or student. In addition to the regular physics topics the book includes physical chemistry and also covers astrophysics, geophysics, and biophysics to some extent, as well as the mathematics which physicists and other scientific workers use. A considerable amount of technical data is given for quick reference and to make the book as self-contained as possible. There is a concise outline of the history of physics and birth and death rates are listed for nearly 900 physicists. Because of the rapid development in so many branches of physics since the last edition of Berliner and Scheel's "Physikalisches Handwörterbuch" this is virtually a new book rather than an enlarged edition of the former, although it fulfills the same purpose. Despite the fact that the book is entirely in German, the clarity and simplicity of presentation make it usable by anyone with a working knowledge of German.

THE PRINCIPLES OF THE CONTROL AND STABILITY OF AIRCRAFT. By W. J. Duncan. Cambridge University Press, 32 East 57th Street, New York 22, N. Y., 1952. Bound, 5½ × 8¾ in., 384 pp., tables, graphs, $8. Following an introductory section on the elementary mechanics of flight, the book deals in a detailed way with the specialized aerodynamic aspects of the subject matter. Among the topics considered are the dynamic equations of rigid aircraft and their solution, flat controls, stalling and spin, influence of structural distortion and air compressibility, and so on. British aerodynamic symbols are

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used but the corresponding American equivalents are listed.

STANDARD METHODS FOR TESTING PETROLEUM AND ITS PRODUCTS. Twelfth edition. Institute of Petroleum, London, England, 1952. Paper, $5^1/_2 \times 8^1/_2$ in., 727 pp., diagrams, charts, tables, 40s. Over 130 test methods, adopted or tentative, are described in this compilation which corresponds to the similar ASTM publication in this country. The test methods cover a wide range; acidity, carbon residue, distillation processes, cloud and pour points, knock-ratings, viscosity, and so on, and special tests such as for the determination of zinc in lubricating oil. Newly added features in this edition are a list of obsolete method numbers and a definition of the precision of standard methods.

TABLES OF THE BESSEL FUNCTIONS OF THE FIRST KIND OF ORDERS SEVENTY NINE THROUGH ONE HUNDRED THIRTY FIVE. (The Annals of the Computation Laboratory of Harvard University, vol. 14), Harvard University Press, Cambridge, Mass., 1951. Bound, $8 \times 10^3/_4$ in., 614 pp., tables, $8. This volume, the twelfth of the "Bessel function" series, completes the tabulation of the family of functions $J_n(x)$ in the interval $0 \leq x \leq 100$ for all integral n to at least ten decimal places. The present volume covers functions of the first kind for orders 79 through 135. Also included is a 15-place table of $J_n(n)$ for integral values of n from 0 to 100. These tables are intended for use in electrical and radio design work as well as for scientists and for mathematicians.

A TEXTBOOK OF MECHANICS. By J. G. Jagger. Blackie Son Limited, Glasgow, Scotland, 1952. Bound, $6^1/_2 \times 9^1/_4$ in., 826 pp., tables, diagrams, graphs, 60s.

Here, in one volume, is covered all the ground the average engineering student is likely to need in his study of statics and dynamics, mechanics of machines, elasticity and vibrations, hydrostatics and hydraulics. Each chapter progresses from the introductory to a reasonably advanced level, stressing fundamental principles but including many illustrative technical applications. The work is also available in four separate volumes.

TEXTBOOK OF WOOD TECHNOLOGY. Volume 2: The Physical, Mechanical, and Chemical Properties of the Commercial Woods of the United States. By H. P. Brown, A. J. Panshin, and C. C. Forsaith. McGraw-Hill Book Company, Inc., New York, N. Y., first edition, 1952. Bound, $6^1/_2 \times 9^1/_2$ in., 783 pp., tables, graphs, $10. Completing a comprehensive two-volume treatment of all phases of wood technology, this second volume covers three major aspects, as follows: The physical properties of wood including bonding and finishing; mechanical properties of wood, including testing procedures, design of typical timber structures, determination of stresses in framed structures, and the holding power of timber connectors; chemical properties of wood. The forestry and commercial timber aspects were covered in volume 1.

THERMODYNAMICS. By Joseph Louis Finck. Flatbush Publications, 440 Rogers Avenue, Brooklyn 25, N. Y., 1951. Bound, $6^1/_4 \times 9^1/_4$ in., 124 pp., tables, graphs, $4. After a critical examination of the foundations of classic thermodynamics the author shows how certain implicit assumptions may be removed to allow the study of thermodynamics from a generalized standpoint. He introduces the concept of a "complete" system, the behavior of which is extended to metastable as well as to the ordinary stable states. This allows a new approach to the explanation of certain problems connected with low-temperature phenomena, catalysis, and other metastable systems.

TRANSPORTATION: Principles and Problems. By Truman C. Bigham and Merrill J. Roberts. McGraw-Hill Book Company, Inc., New York, N. Y., second edition, 1952. Bound, $6^1/_4 \times 9^1/_4$ in. 710 pp., graphs, maps, tables, $6. Designed for college courses in transportation, this textbook covers railroads, motor carriers, pipe lines, airways, and inland coastwise and intercoastal waterways. These forms of transportation are treated jointly from a functional point of view with the primary purpose of promoting the establishment of more rational transportation policies. A historical and factual introduction is followed by material on transport legislation. Rate setting is thoroughly covered, and separate chapters deal with security issurance, labor relations, public aid, and other special aspects. Extensive footnotes and references are provided.

TUNGSTEN: A Treatise on Its Metallurgy, Properties, and Applications. By Colin J. Smithells. Chapman and Hall, Ltd., London, third edition, 1952. Bound, $6^1/_4 \times 9^3/_4$ in., 326 pp., graphs, illus., tables, 75s. This standard reference work provides a comprehensive review of the metallurgy and properties of tungsten and its alloys, and of their industrial applications. The new edition is thoroughly revised in accordance with the developments of the last 15 years. Most of the chapters have been rewritten by experts, with Dr. Smithells assuming the general role of editor.

DIE WASSERERSCHLIESSUNG. Sponsored by Deutscher Verein von Gas- und Wasserfachmännern Vulkan-Verlag. By Dr. W. Classen, Essen, 1952. Bound, $8^1/_4 \times 11^3/_4$ in., 421 pp., tables, graphs, charts, illus., 68 Dm. This comprehensive treatise on the finding and developing of underground water-supply sources is divided into two main parts. Part 1 deals with general geohydrology, the chemistry of groundwater, well-sinking and the installation of equipment, the adaptation of spring flows, pump calculations, and estimation of yield. Part 2 covers geoelectrical prospecting methods, including the limitations and range of applications and discussion of the electrical characteristics of water-bearing ground. Each part has its own index and an extensive bibliography, and a concluding section contains brief technical contributions by consulting firms and equipment manufacturers.

WORK MEASUREMENT: New Principles and Procedures. By Adam Abruzzi. Columbia University Press, New York, N. Y., 1952. Bound, $6^1/_4 \times 9^1/_4$ in., 290 pp., charts, tables, $6. Utilizing a new approach to the evaluation of work performance on an objective basis, this book makes available procedures and criteria for deciding when a process can be considered standardized, and for determining when element and motion standard data have predictive value. It also shows how precise estimates and predictions can be made about the production rates of workers and operations, and how to develop production standards attainable by the workers. Examples are presented to show industrial engineers how to apply these procedures to their own work-measurement problems.

WORK MEASUREMENT MANUAL. By Ralph M. Barnes. Wm. C. Brown and Company, Dubuque, Iowa, fourth edition, 1951. Paper, $8^1/_2 \times 11$ in., 297 pp., tables, diagrams, graphs, $4.75. This manual has been prepared to explain the importance of time study, the procedure commonly used in making a time study, the work-measurement investigations now under way, and some of the preliminary findings. A considerable amount of analytical, graphical, and tabular data is included covering actual studies. There are also a number of reprinted articles on pertinent topics. Emphasis is placed on performance rating and on the study of the accuracy achieved by and to be expected from time-study men.

WORLD POPULATION AND FUTURE RESOURCES. The Proceedings of the Second Centennial Academic Conference of Northwestern University. Edited by Paul K. Hatt. American Book Company, New York, N. Y., 1951. Bound, $5^3/_4 \times 8^1/_2$ in., 262 pp., graphs, $3.50. Twenty papers by specialists in a wide range of fields are broadly classified as follows: the population factor; food resources; material resources of industry; energy resources. In addition to a logical presentation of the problem posed by our expanding world population, certain technological aspects of the problem are emphasized in separate papers: mineral resources and exploitation; the future of structural materials; new products; liquid fuels for the future; solar and atomic energy in the world economy; food technology.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2)

Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting June 13, 1952, and approved by the Board, Aug. 6, 1952 and previously.)

CASE No. 1106-2 (Reopened)

(Interpretation of Pars. U-68, U-69, and U-70)

In *Reply* make the following corrections in the last line of Table 1:

500	550
8000 (instead of 7500)	7000 (instead of 6700)

CASE 1110-1 (REOPENED)

(Interpretation of Par. P-112(c))

Inquiry: May austenitic stainless-steel pipe conforming to one of the grades of specification SA-158 be used for piping under the jurisdiction of Section I of the Code without a stress-relief heat-treatment after welding, as required by Par. P-112(c)?

Reply: (a) It is the opinion of the Committee that thermal treatment, including stress relief, of austenitic stainless steel weldments is neither required nor prohibited; therefore, the joints of all parts of austenitic stainless steel, regardless of thickness, welded under the provisions of Par. P-112 are exempt from the stress relieving requirements of Par. P-112(c).

Cautionary Note: In recognition of controversial opinion relative to the effect of thermal treatment of austenitic stainless steels, mandatory requirements for such have been omitted. Service experience is too limited to permit comparison between the relative safety of as-welded and thermally treated, including stress relieved, austenitic steel weldments, particularly in thick sections. It is suggested that reference be made to the Non-Mandatory Appendix of Par. UHA of the 1952 Section VIII or the Appendix to Case 897-1 (reopened) for suggestions on the selection and use of austenitic chromium-nickel steels.

(b) At least one procedure qualification weld test plate shall be made to represent each lot of piping required for a single boiler unit. One test plate shall be made to represent each type (AISI Type-approximate chemical range) of alloy steel welded with electrodes of the same heat and batch number and subjected to the same heat-treatment (or as-welded).

(c) All welded joints over $^3/_4$ in. thick shall be examined following the hydrostatic test for the detection of cracks by the penetrant oil and powder method. All cracks shall be eliminated.

(d) Welded joints required to be radiographed by the requirements of Par. P-112 (a) (6) shall be radiographed following heat-treatment if heat-tratement is performed.

CASE No. 1147-1 (Reopened)

(Special Ruling)

In *Reply* change the stress value at 500 deg from 7500 to 8000 and at 550 deg from 6700 to 7000.

CASE No. 1156

(Special Ruling)

Inquiry: May copper-nickel alloy tubing conforming to Specification SB-111 be used in power boilers if the tubing is not exposed to products of combustion.

Reply: It is the opinion of the Committee that copper-nickel tubing conforming to Specification SB-111 may be used in the construction of power boilers if the tubing is not exposed to products of combustion. The maximum allowable working pressure shall be determined by the formula in Par. P-26 and maximum allowable design stresses shall be the values given in Table 1 of Case No. 1106-1 and 2 (Reopened).

Proposed Revisons and Addenda to Boiler and Pressure Vessel Code

AS need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code. Simple changes are indicated directly. In the more involved revisions added words are printed in SMALL CAPITALS; deleted words are enclosed in brackets [].

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Power Boilers, 1949

PAR. P-12(b). Revise to read:

(b) Cast Iron as designated in Specification SA-48 for Gray Iron Castings and in Specification SA-278 Gray Iron Castings for Pressure Containing Parts may be used for boiler and superheater connections under pressure, such as pipes, fittings, water columns, valves, and their bonnets, for pressures up to 250 psi, provided the steam temperature does not exceed 450 F (See Par. P-310 for blowoff connections).

PAR. P-23 (a). Substitute the following for the present formulas:

$$t = \frac{PD}{2S + 2yP}$$

and

$$P = \frac{S}{{}^1/_2 (D/t) - y}$$

where t = pipe wall thickness in inches

P = maximum internal service pressure in psi

S = allowable stress due to internal pressure at the operating temperature in psi

y = a coefficient having values as follows:

Temp F	900 and below	950	1000	1050	1100	1150 and above
Ferritic Steels	0.4	0.5	0.7	0.7	0.7	0.7
Austenitic Steels	0.4	0.4	0.4	0.4	0.5	0.7

PAR. P-27 In this new paragraph as it appeared in February, 1952 MECHANICAL ENGINEERING, transpose the last two paragraphs and reletter them.

PAR. P-268(g) (2) Add following sentence

Where vessels are designed to Par. P-180(b) and similar paragraphs, the tensile strength is to be taken as equivalent to 0.8 times the values shown in Table P-7.

PAR. P-270 Revise last sentence to read:

For the purpose of establishing safety valve capacity on new units, the maximum designed steaming capacity as determined by the manufacturer shall be used.

Announcement

Forms P-6 and P-7 for Boiler or Pressure Vessel Reports on Inspection have been revised and combined into one to be known as Form P-6.

Material Specifications, 1949

EDITORIAL NOTE

Since the 1950 Addenda to Section II, Material Specification was issued, the American Society for Testing Materials has brought out 1950 and 1951 Supplements which include revisions of many of its specifications. These have in many cases been adopted by the Boiler Code Committee and some of these will appear in the 1951 Addenda about to be issued. All changes will appear in the 1952 edition of "Material Specifications," but are too extensive to print in MECHANICAL ENGINEERING. Meantime, the following list of specifications that have been revised will enable ordering needed copies from ASTM.

Plates

SA-285-50T, Low and Intermediate Tensile Strength Carbon-Steel Plates of Flange and Firebox Qualities

SA-301-51T, (Grade A & B) Chromium-Molybdenum Steel Plates for Boiler and Other Pressure Vessels

SA-353-52T, Low Carbon, High-Nickel Steel Plate for Pressure Vessels

Castings

SA-339-51T, Nodular Iron Castings

SA-351-52T, Ferritic and Austenitic Steel Castings for High-Temperature Service

SA-352-52T, Ferritic Steel Castings for Pressure Containing Parts Suitable for Low-Temperature Service

PAR. H-38(b) In second paragraph, second line, delete "positive."

Miniature Boilers, 1949

PAR. M-2 Add as new paragraph (between present first and second paragraphs):

Material for use in fusion-welded boilers shall conform to one of the following specifications:

SA- 30—Specifications for boiler and firebox steel for locomotives

SA-285—Specifications for low and intermediate tensile strength plates of flange and firebox qualities.

PAR. M-4(a) Revise last sentence to read: The flat surfaces of boilers or pressure parts shall be stayed in accordance with Par. P-199 to Par. P-204 of Section I of the Code.

PAR. M-4(b) Revise to read:

(b) Miniature boilers may be fabricated by means of fusion welding provided the construction is in accordance with the requirements for material and design of the rules for fusion welding as required by this code.

PAR. M-4(c) Replace with following new paragraph:

(c) Except as specifically provided otherwise in the code, the welding procedure and welding operator qualifications for strength welding shall comply with Section IX of the Code.

PAR. M-4(d) Replace with following new paragraph:

Unless specifically provided otherwise in the code, the tests conducted by one manufacturer shall not qualify a welding operator to do work for any other manufacturer. No production work shall be undertaken until both the procedure and the operator have been qualified.

PAR. M-4(e) Add new paragraph as follows:

The definitions of the fusion welding processes, except as otherwise provided in this code, shall be as stated in Par. P-101(d) of Section I of the Code.

PAR. M-4(f). Add new paragraph as follows:

Neither stress relieving nor radiography of the welded joint is required except that, if the tube ends are welded, the boiler shall be stress relieved.

Unfired Pressure Vessels, 1950

TABLE UG-23 Add the values in Appendix A. This table will be known as Table UCS-23 in the 1952 Edition of the Unfired Pressure Vessel Code and will incorporate these additions.

APPENDIX A—ADDITIONS TO TABLE UG-23 MAXIMUM ALLOWABLE STRESS VALUES IN TENSION FOR CARBON AND LOW ALLOY STEEL IN POUNDS PER SQUARE INCH

Material and Specification No.	Grade	Nominal Composition	Specified Minimum Tensile	Notes	For metal temperature not exceeding deg F: −20 to 650	700	750	800	850	900	950	1000	1050	1100	1150	1200
PLATES																
SA-301	B	1 Cr ½ Mo	60000	..	15000	15000	15000	14750	14200	13100	11000	7500	5000	2800	1550	1000
PIPES & TUBES																
Seamless Carbon Steels																
SA-333	C	..	55000	..	13750											
SA-334	C	..	55000	..	13750											
Seamless Low Alloy Steels																
SA-335	(See Specifications SA-158, SA-206, SA-213, SA-280 for Stresses)															

Tubular Products

SA-155-52T, Electric - Fusion - Welded Steel Pipe for High Temperature & High Pressure Service

TABLE UG-27 Add the values in Appendix B. This table will be known as Table UCS-27 in the 1952 Edition and will incoporate these additions.

APPENDIX B ADDITIONS TO TABLE UG-27, MAXIMUM ALLOWABLE STRESS VALUES IN TENSION FOR CARBON AND LOW ALLOY PIPE AND TUBES OF WELDED MANUFACTURE IN POUNDS PER SQUARE INCH

Specification Number	Grade	Nominal Composition	Weld	Specified Min Tensile	Notes	−20 to 650 F
SA-333	C	Carbon Steel	(Resis)	55000	..	11700
SA-333	3	3½ Nickel	(Resis)	65000	..	13800
SA-333	5	5 Nickel	(Resis)	65000	..	13800
SA-334	C	Carbon Steel	(Resis)	55000	..	11700
SA-334	3	3½ Nickel	(Resis)	65000	..	13800
SA-334	5	5 Nickel	(Resis)	65000	..	13800

SA-334-51T, Seamless and Welded Steel Tubes for Low-Temperature Service

SA-335-51T, Seamless Ferritic Alloy Steel Pipe for High Temperature Service

Forgings

SA-31-51T, Boiler Rivet Steel and Rivets

SA-182-52T, Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings and Valves and Parts for High-Temperature Service

SA-193-51T, Alloy-Steel Bolting Materials for High-Temperature Service

SA-194-51T, Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High Temperature Service

SA-266-51T, Carbon Steel Seamless Drum Forgings

SA-320-51T, Alloy-Steel Bolting Materials for Low-Temperature Service

Low-Pressure Heating Boilers, 1949

FIG. H-1 Delete this Figure for Acceptable Proportions for Ends of Through Stays

PAR. UG-84(d) Temperature of Tests, revise to read:

(d) Temperature of Tests. Impact test specimens shall be tested at the lowest temperature to which the vessel may be subjected in its operating cycle. The test piece, as well as the handling tongs, shall be cooled for a sufficient length of time to reach the test temperature. The test temperature shall be maintained within a range of ±3 F. The specimen shall be quickly transferred from the cooling device to the anvil of the testing machine and broken within a time range of not more than 6 seconds. At testing temperatures below −100 F the piece shall be cooled an extra 5 F, and below −200 F an extra 10 F lower in order to compensate for warming up during transfer.

Announcement

The Council of the Society has approved changing the name of the Code from ASME BOILER CONSTRUCTION CODE to ASME BOILER AND PRESSURE VESSEL CODE.

ASME NEWS

With Notes on the Engineering Profession

Centennial of Engineering 1852–1952

Celebration Attracts Thousands to Chicago

THE records for volume of oratory set at the two recent presidential conventions will have to take a back seat when the convocation of the Centennial opens in Chicago for the 11-day period from September 3 to 13.

According to Lenox R. Lohr, president of the Centennial, it will be the "talkingest" gathering ever held in this country with more than 1000 leading scientists and technical figures slated to appear on the various rostrums. So numerous and varied is the schedule of subjects to be covered by the speakers that many sessions will be going on simultaneously at different meeting places about the city.

With more than 30,000 engineers expected from all over the United States, supplemented by assured delegations from Canada, Latin America, Australia, North Africa, the Far East, and practically all European nations on this side of the Iron Curtain, each of the meetings is expected to draw a large attendance.

Indicative of the immensity of the Centennial speaking program, its managers have taken over the Eighth Street Theater and the grand ballrooms of the Conrad Hilton, Sherman, and La Salle Hotels. These facilities are in addition to the sizable number of smaller meeting rooms that will be used in other hotels all over the Loop and the adjoining Lake Front area and the Centennial headquarters arrangements at the Museum of Science and Industry.

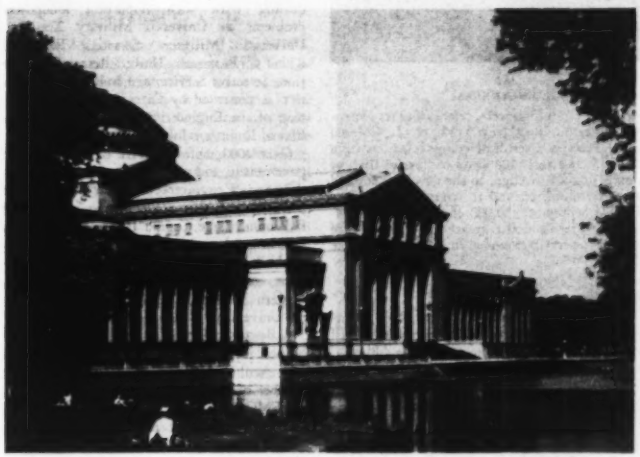
In point of manpower attracted to the Centennial from out of town, the Chicago Convention Bureau reports that it will probably exceed either the Republican and Democratic conventions by at least 10,000 visitors. In addition, its sessions will extend over a period twice as long as either of the political confabs.

Major meetings at the Centennial will cover 12 broad fields of impact on modern living. These meetings will be open to all attendants at the celebration, with the general public also invited to participate. In addition, meetings largely limited to their own members will be staged by most of the 64 individual engineering societies actively identified with the convocation, which includes the ASME Fall Meeting which will be held at the Sheraton Hotel, September 7–11. See the August issue of MECHANICAL ENGINEERING for the program and registration information.

The list of speakers who will be heard on the various programs reads like a "Who's Who" of American science, industry, and education. Included are the chairmen, presidents, or other ranking officers of scores of America's largest business enterprises. Among such companies whose heads will appear as speakers are International Harvester, Swift & Company, Santa Fe Railroad, Standard Oil of Indiana, General Motors, and General Foods Corporation.

A master program was recently published of the Centennial convocation period listing all papers and ceremonies.

By payment of a nominal registration fee, students and the general public may be admitted to all meetings. To have greatest impact on such nontechnical participants, the papers to be presented will be broad in scope and indicate social implications of each phase of technological advance in a manner that may be easily understood by the average layman.



THE MUSEUM OF SCIENCE AND INDUSTRY, JACKSON PARK, CHICAGO, ILL.

("Adam to Atom," a musical pageant enacted daily in the air-conditioned theater of the museum, is a feature of the Centennial of Engineering Celebration. Performances are given at 2:30 and 8 p.m. each weekday and at 2:30, 4:30, and 8 p.m. Saturdays and Sundays through Sept. 15. ASME, one of the participating societies, will hold its Fall Meeting, Sept. 7–11, with headquarters at the Sheraton Hotel; the Centennial celebrations will be held from September 3 through 13.)

President Truman Salutes Centennial

Praise for the part the engineering profession has played in American progress and a boost for the Centennial of Engineering are voiced in a communication from President Harry S. Truman.

Writing from the White House, President Truman said:

"Dear Major Lohr:

"The Centennial of Engineering celebrates a most interesting event in the history of our country. One hundred years ago the profession of engineering was limited almost entirely to military practice. But in the year 1852 the American Society of Civil Engineers was organized to advance engineering in all its branches. Other societies followed quickly and engineering as a civilian profession was soon established.

"The contribution of engineers to America is visible everywhere we go. We see it on the farm where one man is able to produce today more than eight men could a century ago. We see it in improved transportation, which has opened the avenues of commerce and international fellowship to all the peoples of the world. Engineers helped to develop our unparalleled industrial productivity, which has put the good things of life within the reach of all our people. Engineers have shown us how to put our rivers to work so as to check floods, yield power, and convert deserts into gardens. The newest and most dramatic

ASME MARKS CENTENNIAL YEAR OF CIVIL ENGINEERS

(Congratulations are pouring in on the American Society of Civil Engineers, celebrating its centennial year. In a ceremony held in the Engineering Societies Building, New York, N. Y., Colonel C. S. Proctor, *right*, of New York, President of ASCE, receives a scroll of congratulations from R. J. S. Pigott, of Pittsburgh, Pa., President of ASME. It attests 100 years of "useful life" of the civil engineers "devoted to the increase of engineering knowledge, to the development and maintenance of high standards of professional practice and ethics, and to engineering services dedicated to the use and convenience of man." During September, 30,000 engineers, representing 61 American and foreign engineering organizations, will hold the greatest convocation of engineers in history in Chicago, Ill. The Centennial of the ASCE, founded in New York, is the springboard for that occasion.)

challenge to the engineering profession is the boundless horizon of atomic energy applied to industry.

"The Centennial of Engineering will provide the American people with a welcome opportunity to see for themselves the contributions engineers have made to American living. You have my best wishes for a celebration that is successful in every respect."

Governor Stevenson Issues Proclamation

Governor Adlai E. Stevenson, Democratic presidential nominee, issued a proclamation urging public participation in the Centennial of Engineering celebration.

The proclamation follows:

"Whereas, A great Centennial of Engineering, opening July 12 and continuing until September 15, 1952, is to be held in Chicago, and

"Whereas, This Centennial commemorates the one-hundredth anniversary of the founding of the first national society of civilian engineers in the United States—the American Society of Civil Engineers, and

"Whereas, Thousands of scientists and engineers from all parts of the United States, and many engineers and officials from Europe and Latin America are to attend this distinguished two-months meeting, and sixty-one societies will participate in its activities,

"Now, therefore, I, Adlai E. Stevenson, Governor of the State of Illinois, do hereby in official proclamation direct the attention of the people of Chicago and of Illinois to this notable Centennial of Engineering, and request them to do their part in making the occasion a memorable success."

Centennial Day Program

September 10 is designated as Centennial Day. The program starts with a luncheon at 12:30 p.m. to be held in the Ballroom of the Conrad Hilton Hotel. After the invocation, Mayor M. H. Kennelly of Chicago will greet the convocation. Allan S. Quartermaine, president, The British Institution of Civil Engineers, has been invited to extend the greetings on behalf of the entire profession. The response will be made by Carlton S. Proctor, president, ASCE. At this time Benjamin F. Fairless, president, United States Steel Corporation, will be presented with The John Fritz Medal, and the Rt. Hon. Clarence D. Howe, Minister of Trade and Commerce, and Defense Production, Canadian Government, will receive the Hoover Medal. Both recipients will address the meeting.

The Centennial evening party will be held at the International Amphitheatre. Dinner will be served in the second-story wing. After dinner the group will move into a reserved section of the Arena where Charles F. Kettering, Fellow ASME, will deliver an address on the subject, "A Review of the Century."

The evening's festivities will be concluded with a special performance of the Sonja Henie 1953 Ice Review.

Engineering Manpower Shortage

Attention will be focused on the current engineering manpower shortage problem on September 7 in Chicago, when a statement dealing with such important manpower problems as Universal Military Training, Universal Military Service, Expanded R.O.T.C. Proposals, Unified Reserve Legislation, Selective Service, and Industrial Utilization is presented by Carey H. Brown, chairman of the Engineering Manpower Commission of Engineers Joint Council.

Over 1000 representatives of industry, the government, and the military, concerned with shortage of engineers will hear the views of EMC during this conference in the Grand Ballroom of the Conrad Hilton Hotel which will be conducted by general chairman, O. W. Eshbach, president, Western Society of Engineers, member EMC, and dean of Northwestern Technological Institute, Northwestern University.

A discussers' session at the conference will be held by prominent manpower authorities who will point out the alarmingly large number of engineers needed and comment on the EMC program as presented by Mr. Brown. Led by Arthur S. Adams, Mem. ASME, president, American Council on Education, the discussers who will present views are: Hon. William C. Foster, Mem. ASME, Deputy Director of Defense; General Lewis B. Hershey, Director of Selective Service; Harry S. Rogers, Mem. ASME, chairman, Engineers' Council for Professional Development; J. E. Trainer, Fellow ASME, vice-president, Fire-

stone Tire and Rubber Company; and Henry J. Taylor, economist, author, and journalist.

After the reading of the EMC statement and the discussion period, an afternoon open forum will be conducted to present the opportunity for those attending to submit questions to a panel made up of the discussers and Carey H. Brown, Dean Eshbach and A. C. Monteith, Mem. ASME, vice-president of Westinghouse Electric Corporation.

As a wind-up to the day-long engineering manpower conference, A. C. Monteith will present a summary of the program.

Eric Johnston to Speak at Centennial

Eric Johnston, well-known business leader and chairman of the International Development Advisory Board (Point 4), will speak at the September 5 dinner meeting sponsored by the National Society of Professional Engineers.

Mr. Johnston has held many important positions in business and government having been President of the United States Chamber of Commerce, Economic Stabilization Director, and president of the Motion Picture Association.

ASME Committee on Air-Pollution Controls Active

F. S. Mallette Appointed Executive Secretary

APPOINTMENT of Frederick S. Mallette as full-time executive secretary of the ASME Committee on Air-Pollution Controls was announced on Aug. 6, 1952, at Pittsburgh, Pa., by T. E. Purcell, chairman of the committee. Mr. Mallette's duties will be to co-ordinate and expedite the committee's program of co-operation and collaboration with other organizations.

As a result of Mr. Mallette's appointment, Mr. Purcell said, the Society is aggressively promoting the plans which were initiated by the ASME Council when it authorized the formation of the Committee on Air-Pollution Controls in April, 1949, on the recommendation of a special committee which had been appointed in January of that year. Later, with Engineers Joint Council approval, the ASME Council directed the committee to proceed to carry out the Society's program.

Problems of Air Pollution Long Recognized by ASME

The ASME has long recognized the problems of both the public and industry in the field of atmospheric pollution. For many years it supported a committee which studied the problem of air pollution as affected by smoke and dust. In 1949 the Society made a valuable contribution to the field of smoke abatement when the Smoke Law Committee of the ASME Fuels Division prepared and published "Example Sections for a Smoke Control Ordinance," which set forth standards of emission of smoke and dust from industrial processes. These standards, which were based on sound engineering principles and economic possibilities, have been widely accepted by industry and official agencies.

Recognizing the need for technical guidance, the Special Committee appointed by the ASME Council in 1949 recommended the formation of a Committee on Air-Pollution Controls to be composed of representatives of the many organizations which had substantial interest in this field. As a result, some twenty-four representatives held an organization meeting on Nov. 29, 1949, and elected T. E. Purcell chairman.

Committee Sets Up a Program

Immediately this group appointed subcommittees to review representation and to establish a program and the scope of the main committees activities. A Steering Committee approved by the ASME Council in October, 1950, met to discuss the proposed objectives which are, in part, but not exclusively, (1) to initiate and co-ordinate research concerning the health, comfort, nuisance, engineering, and economic aspects of the problem: (2) to collaborate in the formulation and publication of standards of appropriate nature; and (3) to encourage and assist in the preparation, presentation, and publication of papers on the many phases of atmospheric pollution. A seven-point program to implement the objectives was outlined as follows:

(*a*) Sponsoring the preparation and publication of a historical summary of the air-pollution problem.

(*b*) Providing a clearinghouse for information on control projects and trends among manufacturers and public agencies.

(*c*) Defining accepted economic and public-health requirements for the abatement of nuisances or troublesome emissions.

(*d*) Encouraging the preparation of economic analyses to measure efficiencies of various degrees of pollution abatement and the effect on the community or adjacent industry.

(*e*) Fostering the study of fuel use of all types, the actual emissions from different equipment, and the efficient use of all fuels in the best equipment.

(*f*) Stimulating research for the definition of upper limits of emission as influenced by topography, meteorology, and stack discharge location.

(*g*) Developing and codifying specific, approximate, and visual measurements of contamination and density of emission.

Subcommittees Appointed

To carry out this program subcommittees have been appointed as follows:

Subcommittee on Current Projects and Trends, H. B. Lammers, chairman

AIR-POLLUTION CONTROLS COMMITTEE PLANS DISCUSSED AT PITTSBURGH, PA.

(*Left to right:* F. S. Mallette, Executive Secretary, and T. E. Purcell, Chairman, Committee on Air-Pollution Controls meet with R. J. S. Pigott, President, ASME, in Pittsburgh to discuss plans for accelerating the work of the Committee.)

Subcommittee on Health and Industrial Requirements, J. F. Barkley, chairman

Subcommittee on Economics of Air-Pollution Control, G. V. Williamson, chairman

Subcommittee on Fuels and Fuel Burning Equipment, C. E. Miller, chairman

Subcommittee on Co-ordination and Promotion of Research, H. P. Munger, chairman

Subcommittee on Instruments and Measurements, M. D. Engle, chairman

Symposium on Air Pollution Planned

An Air-Pollution Symposium is to be held during the 1952 ASME Annual Meeting, which will be held at the Statler Hotel, New York, N. Y., Nov. 30-Dec. 5, 1952, to bring these problems before the Society membership. The program will emphasize the "non-mechanical" phases, but will also present a paper of direct interest to the Fuels Division, based on a survey of industrial (as contrasted with utility) experience with costs on fly-ash collection and disposal.

The New Executive Secretary

Frederick S. Mallette, as executive secretary of the Committee, will assist the Committee in carrying forward its accelerated program. Mr. Mallette has had more than fifteen years' experience in the engineering, health, and legal phases of atmospheric-pollution problems, and is widely acquainted with the many organizations working in this field. He comes to ASME from the American Steel and Wire Division of United States Steel Company who chose him for the responsible position of Assistant Director of Research in charge of air-pollution control activities. He has been engaged as a consultant to state agencies and to industry in solving air-pollution problems.

The new executive secretary formerly held the Air Hygiene Fellowship at Mellon Institute in Pittsburgh where he participated in special studies of air pollution under the late Harry Meller, a national authority in this field. During World War II Mr. Mallette served on an ASTM War Standards Committee, for which work he received an award from the government.

"Mr. Mallette's appointment to the newly created post," Mr. Purcell pointed out, "marks another step forward in ASME's continual alertness on problems of interest to its members. I am glad that a man with Mr. Mallette's broad experience is now available to the Committee on Air-Pollution Controls. The Society can now look forward to seeing its plans for participation in the important matter of air-pollution control progress effectively."

Seventh Annual Conference Program Announced by ASME Petroleum Division

Headquarters: Hotel President, Kansas City, Mo., Sept. 21–24

THE Seventh Annual Petroleum Mechanical-Engineering Conference sponsored by the Petroleum Division of The American Society of Mechanical Engineers will be held at the Hotel President, Kansas City, Mo., Sept. 21-24, 1942.

Petroleum Promotes Progress

The theme of the technical program is "Petroleum Promotes Progress." The 15 sessions, which make up the program, take up such topics for discussion as control and instrumentation devices, tubular goods and cementing, refinery design, shale-oil developments, pumping problems, pipe-line valves, drilling equipment, refinery insulation, pipeline operation and maintenance problems, design, materials, protective treatment, and natural gasoline and L-P Gas recovery and storage. A panel discussion is scheduled for September 22, at 2:00 p.m. covering compressors in gas pipe-line service—design, station construction, economics, and operating experience. The refinery maintenance symposium will be held on Wednesday. This program was carefully designed to include questions of importance to the mechanical engineer in the petroleum industry and gives ample opportunity for the men engaged in this work to meet and consider ways and methods to further the success and accomplishments, the productivity, and the general advancement in the industry's development.

The inspection trips planned in conjunction with this year's conference are the trip to the Sheffield Steel Kansas City plant where the visitors will be shown electric and open-hearth-furnaces, a bar and rod mill, and the wire department. This trip also includes inspection of the plant of Black, Sivalls & Bryson, Inc., manufacturers of tanks, pressure vessels, valves, safety heads, dehydrators, and the like. The trip to the Sugar Creek Refinery of Standard Oil (Indiana) Company will give the guests an opportunity to see at first-hand the new combination crude and coke unit, research and engineering building, and an outdoor boiler plant.

Social Program

The Honorable William E. Kemp, Mayor of Kansas City, Mo., will greet the participants at the conference welcoming luncheon. The "Heart of America" dinner and entertainment are to be the high lights of the evening. The annual Petroleum Division Banquet is the featured event of the following evening.

The ladies attending the conference are, of course, invited to attend the various luncheons, dinners, and inspection trips; in addition, their special programs also lists a tour of the Nellie Don dress factory, complete with fashion show; the Nelson Art Gallery; and shopping at the famous store in Kansas City.

The Tentative Program

MONDAY, SEPTEMBER 22

9:45 a.m.

Control and Instrumentation Devices

Practical Considerations Regarding Pipe-Line Control-Valve Design, by *Charles F. Woods*, Minneapolis Honeywell Regulator Co., Dallas, Texas

Instrument Application in the Product Pipe-Line Industry, by *Harold R. Hoyt*, Great Lakes Pipe Line Co., Kansas City, Mo.

Tubular Goods and Cementing

Various Methods of High-Pressure-Testing Oil Country Tubular Material, by *H. G. Texter*, Spang-Chalfant Division, National Supply Co., Tulsa, Okla.

American Oil Well Cementing Practice, by *Charles W. Schoenfeld*, The Bullard Co., Bridgeport, Conn.

Refinery Design

Orthoflow Fluid Catalytic Cracking Units—Their Design and Operation, by *William J. Degnen*, and *Joseph F. Shelly*, The M. W. Kellogg Co., New York, N. Y.

Mechanical Design Features of the Cycloversion Process, by *Kenneth W. Seed*, Perco Division, Phillips Petroleum Co., Bartlesville, Okla.

Ammonium-Sulphate From Refinery Waste, by *E. D. Fox*, The Fluor Corporation, Ltd., Los Angeles, Calif.

12:00

Welcoming Luncheon

Presiding: Newby L. Miller, chairman, ASME Kansas City Section, and Lester M. Heckman, president, Kansas City Engineers Club

Welcome: Honorable William E. Kemp, Mayor of Kansas City, Mo.

Response: R. J. S. Pigott, president and Fellow ASME

Remarks: C. J. Eckhardt, ASME vice-president, Region VIII

Speaker: L. P. Cookingham, city manager of Kansas City, Mo.

Subject: **The Engineer in Community Development**

2:00 p.m.

Panel Discussion: Compressors in Gas Pipe-Line Service—Design, Station Construction, Economics, and Operating Experience

Discussers: A. N. Sarich, and C. F. Koenig, 3rd, De Laval Steam Turbine Co., Houston, Texas
H. L. Norris, Jr., Fish Engineering Corp., Houston, Texas
J. F. Eichelmann, El Paso Natural Gas Co., El Paso, Texas
D. R. Croft, Transcontinental Gas Pipe Line Co., Houston, Texas
C. W. Marvin, Texas Eastern Transmission Corp., Shreveport, La.
W. H. Stueve, Oklahoma City, Okla.

Shale Oil Developments

Offsite Facilities of an Oil Shale Industry, by *W. F. Stone*, U. S. Bureau of Mines, Rifle, Colo.

Mechanical Design in Oil Shale Retorting Plants, by *L. H. Brakel*, U. S. Bureau of Mines, Rifle, Colo.

Engineering Features of the Union Oil Shale Retort, by *Homer C. Reed* and *Clyde Berg*, Union Oil Co., Los Angeles, Calif.

Pumping Problems

Reda Pumping of Wells, by *J. F. Boutwell* Reda Pump Company, Bartlesville, Okla.

Sucker Rod Pumps, Mechanical Aspects, by *Ralph R. Renouf*, Service Engineering Enterprises, Inc., Tulsa, Okla.

Electrical Analog Possibilities in Sucker-Rod Pumping Problems, by *E. N. Kemler*, *R. J. Howe*, and *Chang K. Tsai*, department of mechanical engineering, University of Minnesota, Minneapolis, Minn.

6:30 p.m.

"Heart of America" Dinner and Entertainment

Master of Ceremonies: Arthur C. Kirkwood, consulting engineer, Kansas City, Mo.

TUESDAY, SEPTEMBER 23

9:30 a.m.

Pipe-Line Valves

Synthetic Rubber-Sealed Bi-Way Gate Valve, by *H. G. Smith* and *H. G. Doster*, The Ohio Injector Co., Wadsworth, Ohio

Mechanical Development of a Nonlubricated Lift-Plug Valve, by *R. C. Brooks*, Cameron Iron Works, Inc., Houston, Texas

Remote Electric Valve Operation for Crude and Products Lines, by *H. A. Allorfer*, Nordstrom Valve Division, Rockwell Manufacturing Co., Oakland, Calif.

Drilling Equipment

An Investigation of the Bit Forces in Rotary Drill-

ing and Their Measurement With a Bottom Hole "Weight Indicator," by *Harold J. EnDean* and *William M. Laird*, Gulf Research and Development Co., Pittsburgh, Pa.

Recent Developments in Drill Bits and Drilling Methods, by *H. D. Woods*, Hughes Tool Co.

Refinery Insulation

Low-Temperature Insulation for Refinery Service, by *W. L. Martin*, Humble Oil & Refining Co., Baytown, Texas

Improved Methods for Fireproofing Structures, by *C. J. Kubasz*, The M. W. Kellogg Co., New York, N. Y.

New Procedures in Industrial Insulation Application, by *E. C. Shumen*, Owens-Illinois Glass Co., Toledo, Ohio, and *C. J. Kubasz*, The M. W. Kellogg Co., New York, N. Y.

12:00

Operating Committee Luncheon

Production: M. P. Watson, chairman, United Gas Pipe Line Co., New Orleans, La.
Materials: M. A. Scheil, chairman, A. O. Smith Corp., Milwaukee, Wis.
Refining: C. R. Draughon, chairman, Esso Standard Oil Company, Baton Rouge, La.
Transportation: A. H. Newberg, chairman, Service Pipe Line Co., Tulsa, Okla.
Manufacturers: T. D. White, chairman, Commercial Shearing and Stamping Co., Youngstown, Ohio

7:00 p.m.

Banquet

Presiding: Howard E. Degler, chairman, Kansas City Arrangements Committee
Toastmaster: Linn Helander, department of mechanical engineering, Kansas State College, Manhattan, Kan.
Remarks: B. B. Morton, chairman, ASME Petroleum Division
Speaker: R. J. S. Pigott, president and Fellow ASME

WEDNESDAY, SEPTEMBER 24

9:15 a.m.

Pipe-Line Operation and Maintenance Problems Crude Oil Working Tanks—Design, Construction, Operation, and Maintenance Considerations, by *R. M. Carter*, Service Pipe Line Company, Tulsa, Okla.

Pipe-Line Scraper Development, by *T. D. Williamson, Jr.*, T. D. Williamson, Inc., Tulsa, Okla.

The Construction of High-Pressure Gas Lines From the Gulf of Mexico for Inland Distribution, by *A. M. Croswell*, Gulf Southern Contractors, Fort Worth, Texas

Design

Packaged Gasoline Plants, by *Charles B. Barry*, Blaw Knox Co., Tulsa, Okla.

Direct-Fired Heaters for Natural Gasoline Plants, by *Harold J. Born* and *George F. Rose*, Born Engineering Co., Tulsa, Okla.

Materials

Some Possible Applications of Ductile Iron in the Petroleum Industry, by *K. J. Rice*, The International Nickel Co., Inc., Houston, Texas

Modern Steel Bolting for Piping and Pressure Vessels, by *C. M. Vogris*, The M. W. Kellogg Co., New York, N. Y.; *Frank S. G. Williams*, Taylor Forge & Pipe Works, New York, N. Y.; and *John S. Worth*, Bethlehem Steel Co., Bethlehem, Pa.

1:30 p.m.

Symposium on Refinery Maintenance

Refinery Maintenance During Operation, by *Claude H. Trotter*, Phillips Petroleum Co., Bartlesville, Okla.

Onstream Maintenance—What and How, by *J. O. Thoen* and *Lloyd G. Foster*, Continental Oil Co., Ponca City, Okla.

Maintenance Work on Refining Units During Operations, by *W. J. Buxton*, Standard Oil Co. (Indiana), Whiting, Ind.

Tooling for Refinery Maintenance, by *H. S. Selinth*, C. F. Braun & Co., Alhambra, Calif.

Protective Treatment

Full-Scale Fatigue Testing of Compressor Cylinders, by *T. O. Kuivinen*, Cooper-Bessemer Corp., Mt. Vernon, Ohio

Preservation Treatment of Existing Cooling Towers, by *D. R. Baker*, The Marley Co., Inc., Kansas City, Mo.

Natural Gasoline and L-P Gas Recovery and Storage

Economic Aspects of Natural Gasoline Production on the Lease, by *Wickliffe Skinner, Jr.*, Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.

Subsurface Storage of Liquid Hydrocarbons, by *Neal Van Fossan*, Slick-Urschel Oil Co., Midland, Texas

Women's Program

MONDAY, SEPTEMBER 22

Registration

9:45 a.m. Coffee and Get Acquainted Party
1:45 p.m. Tour of "Nellie Don" dress factory; style show and dress prizes
5:30 p.m. Social Hour, Ball Room Foyer
6:30 p.m. "Heart of America" Dinner

TUESDAY, SEPTEMBER 23

12:00 Ladies Luncheon, Talk on "Flowers and Their Arrangement," by Marti Peed
6:00 p.m. Social Hour, Ball Room Foyer, Dutch Treat
7:00 p.m. Annual Petroleum Division Banquet

Inspection Trips

1:00 p.m. Inspection Trip to Sheffield Steel Plant, and Black, Sivalls & Bryson, Inc.
1:30 p.m. Inspection trip to Sugar Creek Refinery of Standard Oil Company
2:00 p.m. Kansas City Sight-seeing trip (1951 flooded area, Swope Park and residential area)

University Center, Mexico City

ACCORDING to a recent issue of *UNESCO World Review* a new University Center is being constructed at the southern edge of Mexico City, called El Pedregal.

Mexico has long prided itself for having given birth to the first university in North America back in 1551. Now it will possess one of the largest and most modern university centers in the world, The Ciudad Universitaria.

In the past, university education in Mexico, though noted for its high cultural and scientific level, was almost exclusively centered around classroom activities and a few scattered social functions. Campus life was unknown and there were few facilities for housing students from out of town. Now, in the new University Center, students will enjoy a well-rounded university life.

According to officials, no other university in the world will match the Mexico City center in athletic fields of every description. Included will be a large artificial lake with sandy beaches, facilities for swimming and diving competitions and a capacity of 1500 persons. There will also be an olympic stadium large enough to hold 110,000 spectators.

The Administration building is one of the first to near completion. It is a fourteen-story structure. Not far away is the central library—a large towerlike building that features four mosaic façades. The mosaics are made from colored stones brought from all parts of the Republic. Their theme is an illustration of the history and culture, of Mexico.

Other buildings are the Hall of Human Relations, and the Research Institute, which forms part of the great Hall of Science. Also completed or near completion are the school of economics, the law school, the schools of philosophy, of commerce, of engineering, and of architecture. There are also schools of medicine, of dentistry, and of chemistry. The project has given Mexican architects an excellent opportunity to translate their newest theories into modern structures.

Mexican and foreign students will do research work together in the Hall of Cosmic Rays. In this building will be housed a neutron measuring unit lent to Mexico by the University of Massachusetts. There is also an Institute of Nuclear Physics completely lined with aluminum plates. Here, will stand a modern atom disintegrator, the first of its kind in Latin America. Mexican scientists will soon begin nuclear-physics research designed to discover new peacetime uses for atomic energy.

Educators from all parts of the world have already visited the grounds of the new University Center and many of them have expressed their conviction that the Center will place Mexico in the forefront of university education—and that it will greatly contribute to scientific, educational, and cultural advancement in Latin America.

ASME Calendar of Coming Events

Sept. 7–11
ASME Fall Meeting, Sheraton Hotel, Chicago, Ill.
(Final date for submitting papers was May 1, 1952)

Sept. 8–12
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Cleveland Auditorium, Cleveland, Ohio
(Final date for submitting papers was May 1, 1952)

Sept. 22–24
ASME Petroleum Mechanical-Engineering Conference, Hotel President, Kansas City, Mo.
(Final date for submitting papers was May 1, 1952)

Oct. 30–31
ASME Fuels and AIME Coal Divisions Joint Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.
(Final date for submitting papers was June 1, 1952)

Nov. 30–Dec. 5
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers was July 1, 1952)

April 28–30, 1953
ASME Spring Meeting, Deshler-Wallick Hotel, Columbus, Ohio
(Final date for submitting papers—Dec. 1, 1952)

May 24–28, 1953
ASME Oil and Gas Power Division Conference, Hotel Schroeder, Milwaukee, Wis.
(Final date for submitting papers—Jan. 1, 1953)

June 28–July 2, 1953
ASME Semi-Annual Meeting, Hotel Statler, Los Angeles, Calif.
(Final date for submitting papers—Feb. 1, 1953)

Sept. 21–25, 1953
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Chicago, Ill.
(Final date for submitting papers—May 1, 1953)

Sept. 28–30, 1953
ASME Petroleum Mechanical-Engineering Conference, Rice Hotel, Houston, Texas
(Final date for submitting papers—May 1, 1953)

Oct. 5–7, 1953
ASME Fall Meeting, Hotel Sheraton, Rochester, N. Y.
(Final date for submitting papers—July 1, 1953)

Nov. 29–Dec. 4, 1953
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1953)
(For Meetings of Other Societies see page 772)

Policies on ASME Budget for 1952–1953

THE following statement of policies with the schedule of income and expense constitutes the Budget for 1952–1953.

1 A continuous effort will be made to collect dues.

2 No appropriation shall be made by Council without first referring back to the Finance Committee for recommendation. When a liability is assumed the means for paying for it shall be provided in advance.

3 No new activity shall be undertaken without definitely showing that the funds required to support it will be available without decreasing the appropriations for existing essential activities, giving the consideration to the administrative expense that may be involved. When a new activity is authorized if the additional funds to support it are not directly available from the unappropriated income, Council shall say what activity shall be curtailed or suppressed to permit transference of the fund required to support the new activity. If the budget of expenses is to be reduced, the Council shall say what activity shall be curtailed or suppressed.

4 The Society shall hold four general meetings with expense chargeable to the budget. A fee shall be charged to nonmembers for admission to general or technical sessions at the four meetings of the Society according to rules established by the Board on Technology. No payments will be made for rental of rooms for the holding of technical sessions.

5 Council meetings shall be held at the place and time of the Annual and Semi-Annual Meetings. Council representation within the budget shall be provided for the other national meetings.

6 Within the allowance of the budget, Vice-Presidents shall be expected to visit Sections and Student Branches and attend Student Branch Conferences in their Regions or arrange for visits by their representatives.

7 No travel allowance will be provided for Board and Committee Chairmen attending Council Meetings except upon special provision of Council or the Executive Committee.

8 Eight Regional Administrative Committee meetings will be held.

9 A Regional Delegates Conference will be held at the place of the Semi-Annual Meeting.

10 The Nominating Committee may hold a preliminary meeting at a place to be selected and a Selection Meeting at the Semi-Annual Meeting within the provisions of the budget.

11 The following uniform basis of contribution toward travel expense shall be adopted: Full railroad fare including Pullman (not to exceed roomette rate) plus government tax, or airplane fare, plus $6 per day for actual travel time (not to exceed travel time by standard railroad route), plus $6 per day for days on required business at meeting.

These payments will be made upon submission of a report on a form supplied by the Secretary.

For Student Branch Conference—16 cent

COMBINED ANALYSIS OF EXPENDITURE BUDGET 1952–1953

Under Committee Supervision

	Direct Expenditures	Joint Bodies	Members Travel	Printing and Distribution	Office Expense	Total
PUBLICATIONS, STANDARDS, CODES AND RESEARCH						
MECHANICAL ENGINEERING text pages (excluding student copies)				$ 85,000.00	$ 44,566.00	$ 129,566.00
MECHANICAL ENGINEERING advertising pages (excluding student pages)				140,100.00	103,611.00	243,711.00
Transactions (including *Journal of Applied Mechanics*)	$ 1,100.00			13,800.00	22,570.00	37,470.00
Membership List				12,000.00		12,000.00
ASME Catalog				55,000.00	40,361.00	95,361.00
Publication sales (except standards, codes, and research reports)				76,000.00	22,031.00	98,031.00
Standards and codes		$ 1,000.00		80,500.00	82,018.00	163,518.00
Research				700.00	11,257.00	11,957.00
"Know Your Society" (organization charts)				500.00		500.00
GENERAL SOCIETY ACTIVITIES						
Society meetings (including publicity)	33,000.00				26,800.00	59,800.00
Sections (including regional administration Committee of Regional Delegates Conference)	75,000.00		$24,100.00		23,761.00	122,861.00
Professional Divisions	10,000.00				10,640.00	20,640.00
Student Branches (including copies of MECHANICAL ENGINEERING text and advertising pages)	7,000.00		4,500.00	36,000.00	15,594.00	63,094.00
Admissions					26,587.00	26,587.00
Development					6,980.00	6,980.00
Awards	1,100.00				744.00	1,844.00
Engineers Civic Responsibility	500.00					500.00
GENERAL SOCIETY ADMINISTRATION						
Council	2,300.00		9,200.00			11,500.00
Professional services (auditors, counsel, etc.)	6,500.00					6,500.00
Nominating Committee			2,800.00			2,800.00
Retirement Fund	38,000.00					38,000.00
JOINT ACTIVITIES						
Engineering Societies Library		16,580.00				16,580.00
Engineers' Council for Professional Development		2,100.00				2,100.00
Engineers Joint Council		1,600.00				1,600.00
Engineering Societies Personnel Service, Inc. (reserve)		500.00				500.00
Registration (National Council of State Boards of Engineering Examiners)		500.00				500.00
UET Pension Fund		3,500.00				3,500.00
National Management Council		500.00				500.00
INDIRECT EXPENSE						
Secretary's office					56,460.00	56,460.00
Accounting department					48,222.00	48,222.00
General service (stores, mailing, filing, etc.)					97,354.00	97,354.00
General office (rent, insurance, etc.)					53,834.00	53,834.00
	$174,500.00	$26,280.00	$40,600.00	$499,600.00	$693,390.00	$1,434,370.00

per mile for each Student Branch Delegation, including the honorary chairman. Student delegations under this provision may consist of (*a*) the honorary chairman, (*b*) the honorary chairman and at least one student-delegate, or (*c*) one or more student delegates.

Visits of Presidents and Vice-Presidents or their designated representatives of Sections, Branches, etc.—out of pocket expense within budgetary limits prescribed.

12 Payments to the Sections for Operation shall be on the basis of the Standard Formula plus 25 per cent. The Standard Formula is: $3.50 per member for the first 75 members, $1.50 per member for the next 425, $1.25 per member for the next 500, $1 per member for all over 1000, and $150 to each Section for each authorized Subsection.

Any payments to a Section in addition to those paid on the Standard Formula shall require authorization by the Council.

Payments by the Section shall be made in accord with the Sections Operation Manual, and the Secretary's Staff has authority to deny reimbursement for payments not so made.

13 Grants of Society funds for Section, Division, and Student Branch operations shall not be used for social events.

14 The Society shall have two representatives on the American Standards Association.

15 No publication shall be printed for sale unless there is reasonable assurance of sufficient orders to pay for the cost.

ESTIMATED COSTS—ASME ACTIVITIES

	Budget 1952–1953	
INCOME ACTIVITIES		
MECHANICAL ENGINEERING and Mechanical Catalog Income	$550,000.00	
Less production costs, wages, and indirect	404,692.00	
		$145,308.00
Engineering Index		4,000.00
Miscellaneous sales		5,000.00
Interest, dividends, and discount		23,000.00
Membership dues		575,000.00
TOTAL		$752,308.00
ACTIVITIES CARRIED ON AT A NET COST		
General Publication Sales Income	$117,500.00	
Less stock costs, wages, and indirect	117,974.00	
		474.00
MECHANICAL ENGINEERING text (production, wages, and indirect)		154,357.00
Transactions (production, wages, and indirect)		45,994.00
Membership List (production, wages, and indirect)		14,125.00
Organization charts (production and indirect)		581.00
Standards and codes (income)	$139,000.00	
Stock costs, wages, and indirect	195,540.00	
		56,540.00
Research (income)	1,500.00	
Stock costs, wages, and indirect	14,276.00	
		12,776.00
Student dues	24,000.00	
Student expense (production, wages, and indirect)	74,629.00	
		50,629.00
Meetings (income)	2,000.00	
Meeting expense (costs, wages, and indirect)	70,716.00	
		68,716.00
Sections (appropriations, travel, wages, and indirect)		145,098.00
Divisions (appropriations, travel, wages, and indirect)		24,698.00
Admissions and Development (wages and indirect)		40,486.00
Awards (costs, wages, and indirect)		2,164.00
Engineers Civic Responsibility		500.00
Joint Activities		47,303.00
General Administration		81,231.00
TOTAL		$745,672.00
NET INCOME		$ 6,636.00

Junior Forum

Conducted by Joseph Schmerler[1]

What's in It for Me?

OUTSIDE of an action based on sheer altruism, "What's in it for me," is behind every movement a person makes. This question assumes varying proportions according to the individual. Too great a preoccupation with this matter makes a person greedy, too little shows a lethargic nature.

The correct emphasis on this subject, in so far as an engineer is concerned, was brought out in a talk by Harvey Donald Moll, Jun. ASME, field engineer, Elliott Company, Philadelphia, Pa., at a meeting of the Washington Junior Group of ASME on March 13, 1952.

While Mr. Moll conceded that rising living costs, and delay in career due to military service are factors which tend to make the junior engineer think of a quick monetary return, he noted that similar barriers or hurdles, have always existed in one form or another, and it is primarily up to the individual to surmount them. American industry, he said takes care of the men working for it, if they produce and show an interest in their job. Industry pays only for work accomplished, never for expected results alone.

To illustrate this point Mr. Moll told the story of a certain young man who had worked his way up in a mill from laborer to foreman, and then to superintendent. To do this he had been willing to produce a little more than average, work a little longer than average, study his job in the evening, and do some extra schoolwork. One day he and his superior were walking through the plant and he made the comment that men today were not interested in doing a full day's work. His superior replied, that is why you are superintendent and not still a laborer.

The United States has become a great nation because of the free enterprise system. The engineer, as an individual, has played an important part in this rise because he is curious, always looking for a better, less expensive way of doing a job. He has never said that the way Dad did it is the best way and he would also do it that way.

For this reason, engineering is an expanding field. To the question, "What's in it for me—in engineering?" the answer is, "Opportunity." Opportunity in so far as personal advancement is concerned and opportunity to render service. Mr. Moll mentioned that new fields are being developed and old ones expanded. Modern central utility stations, for example, are becoming so complex that operating personnel require "know-how" far in excess of what the companies ever thought would be needed. Mechanical engineers have expanding horizons in the operation of oil refineries, chemical plants, and the like. Little investigation had previously been made in these fields by mechanical engineers, whose thinking was primarily in terms of power plants and machine design.

Besides the material opportunity in engineering there is also the opportunity to build the profession. Mr. Moll said he has often been asked what can a man gain if he becomes active in ASME. His answer is always that you get out of a society or organization only what you put into it. His advice is for the individual to take stock of himself; check his professional development. The Junior Forum, in the March, 1952, issue of MECHANICAL ENGINEERING, pp. 267–268, carried a check list on professional development and in the February, 1952, issue, pp. 179–180, discussed the steps involved in such progress. It is the key to an engineer's material, professional, and social success.

[1] Design Engineer, Celanese Corporation of America, New York, N. Y. Jun. ASME.

Meetings of Other Societies

Sept. 14–19
American Chemical Society, one hundred and twenty-second national meeting, The Traymore, Atlantic City, N. J.

Sept. 17–Oct. 4
International Machine Tool Exhibition, London, England

Sept. 22–25
The American Mining Congress, 1952 convention and exposition, Denver, Colo.

Sept. 22–24
American Coke and Chemicals Institute, annual meeting, White Sulphur Springs, W. Va.

Sept. 24–26
Heat Exchange Institute, Skytop Lodge, Skytop Pa.

Sept. 29–Oct. 1
National Electronics Conference, eighth annual conference Sherman Hotel, Chicago, Ill.

Sept. 30–Oct. 3
Association of Iron and Steel Engineers, 1952 iron and steel exposition and annual convention, Cleveland Public Auditorium, Cleveland, Ohio

Oct. 1–4
Society of Automotive Engineers, national aeronautic meeting and aircraft engineering display, Hotel Statler, Los Angeles, Calif.

Oct. 3–4
American Society for Quality Control, sixth New England conference, Sheraton Hotel, Worcester, Mass.

Oct. 9–11
Optical Society of America, thirty-seventh annual meeting, Hotel Statler, Boston, Mass.

Oct. 13–17
American Institute of Electrical Engineers, fall general meeting, Jung Hotel, New Orleans, La.

(For ASME Calendar of Events see page 769)

Industrial-Engineering Films Now Available

THE Bureau of Audio-Visual Instruction of the State University of Iowa has released a revised edition of two of its most important sound films: "Motion Study Principles" and "Motion Study Applications."

These films were originally produced by the Bureau of Audio-Visual Instruction under the direction of Prof. Ralph M. Barnes, Mem. ASME, and have had such wide acceptance that a revised edition has been prepared.

The entire film has been retaken and the new prints are now available on a rental or sales basis by the State University of Iowa, Bureau of Audio-Visual Instruction, Iowa City, Iowa.

U-919, MOTION STUDY PRINCIPLES (Revised), 990 ft, showing time 28 minutes. Rental $4 for one or two days. Sale price $75. The purpose of this sound film is to present some of the most important principles of motion economy and to illustrate how these principles may be applied to specific operations.

U-979, MOTION STUDY APPLICATIONS (Revised), 660 ft, showing time 18 minutes. Rental $4 for one or two days. Sale price $75. This film defines the most common hand motions and shows how an understanding of this classification of motions together with a knowledge of motion study principles enables one to develop better and easier ways to work.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th Street	84 East Randolph Street	100 Farnsworth Ave.	57 Post Street

Men Available[1]

Stress Analyst, 35, BS, MS, and ScD in applied mechanics; 3 years' teaching experience; 3 years' research experience; author of many technical papers. Interested in stress analysis or vibration work in metropolitan N. Y. area. Me-894.

Gas-Turbine Engineer, 28, BME, MS, two years test; five years' design and development in gas turbines with major turbine manufacturer. Desires position in commercial, jet, or related field. East. Me-895.

Power-Plant Engineer, 52, BS, 28 years' mechanical, electrical, and administrative experience in steam-power generation, desires operating position in either power or process plants. Me-896.

Engineer, 30, married, BSME, Pi Tau Sigma. Three and a half years' extensive experience in drilling practices, maintenance of equipment, purchasing equipment and repair stocks, design and construction supervision of oil-handling facilities cost estimates, and pay-out statements with major oil company in South America. Working knowledge of Spanish. Now located in Venezuela. Desires to relocate in foreign work not necessarily oil industry. Me-897.

Mechanical Engineer, 54, 30 years' practical and technical experience in administration, responsible for research, design of special tools, machinery and development, desires opportunity to apply one's own initiative, and originate personal ideas, broad ideas in design. Interesting background. Available 6–8 weeks after contract. Prefers non-metropolitan N. Y. Me-898.

[1] All men listed hold some form of ASME membership.

Positions Available

Chief Plant Engineer, experience in heavy equipment. Must possess high level of general ability enabling him to organize a plant engineering staff for a new plant and to direct its activities in later operations. Salary open. Midwest. V-7294-D-7859.

Mechanical Engineers. (*a*) Mechanical and chemical engineers, recent graduates preferred, for technical training group. $3900–$4200, for BS degree. (*b*) Mechanical engineer, graduate, several years' experience in maintenance of heavy equipment such as is found in a steel or rolling mill. $7200–$8400. Also two young men, lesser experience; one mechanical and one electrical. $4800–$5100. (*c*) Mechanical engineers for general plant engineering, graduates desired, with plant engineering experience such as design, construction, piping, layouts, etc. $4800–$6000. (*d*) Mechanical engineers, graduates, machine-design experience, for machine and process-development department. $4800–$6000. (*e*) Mechanical engineer for aeronautical division. Work at outset will be on drafting board. $4200. Ohio. Y-7302-D-7858.

Designer to be responsible for developing designs for machinery, tools, or equipment, and/or plans for its installation or layout as assigned. $5400–$6240. N. J. Y-7329.

Mechanical Engineer. Must have BSME, to work as plant engineer. Will be responsible for installation of equipment, alterations, maintenance, safety, and supervision of most functions. Someone who has headed a plant-maintenance program or one who has been assigned to a well-functioned preventive maintenance program would be desirable. Must have good ability and be tactful as he will come in contact with government, state, and local inspectors, etc., who inspect elevators, ventilation, etc. $5000–$6000. N. Y. metropolitan area. Y-7347.

Engineers. (*a*) Research and development engineer, five to ten years' experience in the research and development of mechanical and electromechanical parts and mechanisms. $10,000. (*b*) Mechanical engineer or physicist, young, two or three years out of school for work on mechanical analysis and testing. $5000. New York, N. Y. Y-7363.

Mechanical Engineer, 38–48, for design and development work, for company manufacturing clocks. Must have had experience on small mechanisms and preferably some knowledge of electricity. Will eventually become chief engineer. $7500. New York, N. Y. Y-7379.

Industrial Engineer, 30–45, with several years' experience in wage-incentive installations. Experience in woodworking industries, particularly furniture, millwork, etc., absolutely necessary. Headquarters, Wis. Y-7381.

Chief Engineer of research department, preferably under 45, thorough background in mechanical design experience covering business-machine field or allied line. $15,000–$20,000. Midwest. Y-7391.

Design Engineer, experience covering design of light mechanical items, to design and detail paper and metal products in office-equipment field. $5000–$6000. Westchester County, N. Y. Y-7392.

Mechanical Engineer, young, to do outline work on drafting board, handle details of inspection, etc. Will work under supervision of assistant chief engineer. Small company engaged in power-plant construction including design and installation of boilers and all auxiliary equipment. $3640–$3900. New York, N. Y. Y-7393.

Designer of automatic machinery, for manufacturers of electric capacitors, filters, resistors, transistors, etc. The machines designed are for the automatic manufacture of very small precise and intricate parts for electronic products. $5800–$7400. Mass. Y-7394.

Industrial Engineer, at least ten years' manufacturing and financial experience in metal-products fields, to make production surveys, analyze financial conditions, prepare reports and recommend advisability of government contract awards. $8300–$9600. New York, N. Y. Y-7397.

Assistant Manager, mechanical or industrial graduate, aircraft maintenance experience, to schedule overhauls, be responsible for production, cost, and inventory controls, and assume general administrative charge of air-transport modification, maintenance, and repair. $8000–$10,000. Southwest. Y-7411.

Mechanical Engineer, at least five years' plastic fabrication experience in compression and extru-

(ASME News continued on page 774)

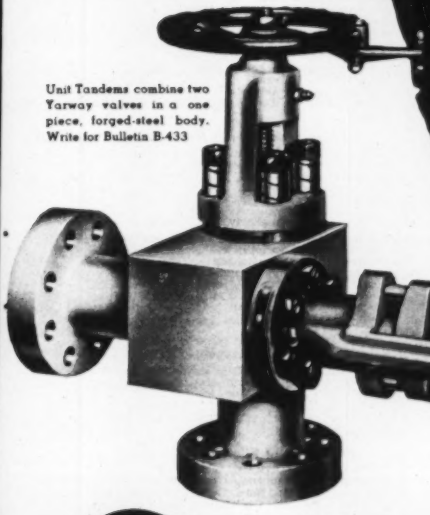
IN FAR OFF INDIA IT'S YARWAY

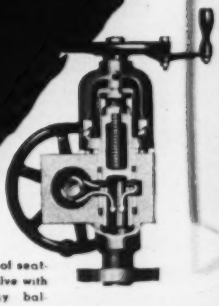
KISTAN

NEPAL

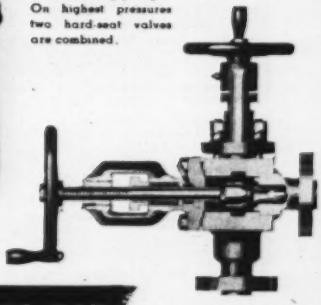
24

Unit Tandems combine two Yarway valves in a one piece, forged-steel body. Write for Bulletin B-433





Cross section of seatless sealing valve with famous Yarway balanced sliding plunger. On highest pressures two hard-seat valves are combined.



Cross section of hard-seat blowing valve with mated stellite-faced disc and integral welded-in stellite seat.

. . . YARWAY SERVICE GOES ALL THE WAY

sion fields, to assist chief engineer in fabricating plant. $6000. N. J. Y-7417.

Sales and Installations Engineer, graduate, aeronautical, mechanical or electrical, who has had sales experience and an aeronautical background for sales and field work for an aeronautical company. Some traveling. $4920–$5491. Headquarters, northern N. J. Y-7419.

Draftsman, 25–40, five years' experience in layout of boilers, tanks, or heavy equipment. Knowledge of stresses and strains of materials. Will lay out and design mechanical phases and structures of power transformers for a manufacturer. Company will negotiate placement fee. Mich. T-9067(*b*).

Engineers. (*a*) Assistant chief engineer, over 28, mechanical, two to five years' experience in administrative and development engineering. Will work under direction of chief engineer on administrative engineering on development of automotive oil filters. Company will pay moving expenses and negotiate placement fee. Salary open. (*b*) Project engineer, over 28, mechanical or automotive, three years' experience in development engineering. Will work under assistant chief engineer on projects involving development of automotive oil filters. Company will pay moving expenses and negotiate placement fee. $6000. Southern Wis. T-9052.

Mechanical Research Engineer, mechanical, aeronautical, or civil, five years' experience in stress-analysis theory of structures or structural-design analysis. Must be able to write good reports. Knowledge of mechanical structures; informed about mathematics and materials. Will be responsible for research projects involving structures, dynamics, plasticity and instrumentation. Must have P.B.I. clearance. Salary open. Ill. R-9051.

Development-Design Engineer, mechanical, five years' experience in designing and developing precision equipment. Knowledge of optical instruments helpful. Will design and develop optical instruments. $6240. Company will negotiate placement fee. Ill. R-9070.

Executive Engineer, mechanical, 30–50, five years' experience in design of small mechanisms for automotive work in administrative capacity. Will do administrative or executive engineering work in conjunction with automotive accessories and mechanisms for manufacturer of auto accessories. Up to $12,000. Ill. R-9077.

Engineers. (*a*) Factory manager, up to 45, five years' experience in manufacturing gears or machining work on precision products. Knowledge of machine-shop operations. Will supervise the manufacturing of gears and special machined products. $9500. Company may pay placement fee. (*b*) Chief process engineer, up to 45, five years' experience processing machined parts, gears, or similar products. Knowledge of tooling, feeds, and speeds of machine. Will do processing of gears and machined parts for very close-tolerance precision work. $8000–8500. (*c*) Chief inspector, up to 50, five years' experience in supervisory inspection work on close-tolerance precision products. Knowledge of machine-shop operations. Will set up and supervise tight inspection system for manufacturing gears and machined parts on close-tolerance precision work. $8000–$8500. (*d*) Sales engineer, 30–45, mechanical, two years' experience in sale of gears or transmission products. Will sell a line of custom-built gears to automobile companies. Up to $15,000. Car required. Travel 50 per cent of time. Company may pay or negotiate placement fees. Ill. R-9084.

Application Engineer, up to 57, mechanical, familiar with processing operations of paper and pulp industries or petroleum industry. Will serve in advisory capacity to manufacturing and sales departments for company making pumps, Diesels, and other products sold to afore-mentioned industries. Up to $10,000. Company may negotiate placement fee. Ill. R-9085.

Director of Engineering and Research, 32–50, mechanical or chemistry, three years' experience in administrative capacity in product development. Knowledge of plastics and mechanical products. Duties involve directing and coordinating engineering and research for development of semi-consumer products for manufacturer. $13,000–$18,000. Mich. R-9102.

Gear-Production Supervisor, 35–45, mechanical degree, seven years' experience in production processing of gears and gear housing. Will assist in the plant layout and setup for a complete transmission production operation. Following this, assume full responsibilities for operation of the department for manufacturer of tractors. $7200 and up. Company will negotiate placement fee. Ill. R-9103.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Sept. 25, 1952, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

ABROMATIS, JOHN P., Bridgeport, Conn.
ARNOLD, HEWETT R., Drexel Hill, Pa.
ATKINS, ROBERT D., St. Paul, Minn.
AUGUST, NICHOLAS P., Schenectady, N. Y. (Rt & T)
BARDELLI, ARTHUR C., Milton, Mass.
BEHNKEN, HAROLD A., Roselle Park, N. J.
BENSON, WILLARD R., Dover, N. J.
BLAKEMORN, ROBERT H., Lancashire, England
BORCKMANN, ROBERT H., New York, N. Y.
BORRY, JOHN V., Minneapolis, Minn.
BRAND, HARRY R., Jr., New York, N. Y.
BROUWERS, A. P., ROTTERDAM, (W) Holland
CHRISTENSEN, C. LINCOLN, University Heights, N. Y.
DESAI, KRISHNARHAI, Brooklyn, N. Y.
DE SOUSA, CAJETAN H., Bombay, India
DIMOND, THOMAS H., Detroit, Mich.
DURRST, JOHN F., Auburn, Ala.
EBERHARDT, H. A., Easton, Pa.
EVRING, CART T., Phoenix, Ariz.
FIRTH, CHARLES J., Philadelphia, Pa.
FOLK, SAMUEL B., Columbus, Ohio
FOLTZ, ARTHUR L., Jr., Detroit, Mich.
GALLAGHER, JOSEPH G., Los Angeles, Calif.
GERHARDT, HOWARD C., Sr., Savannah, Ga.
GREW, RAYMOND E., Woodbury, N. J.
HALL, CARL W., E. Lansing, Mich.
HEISS, OTTO W., Newton, Conn.
HOLLAND, ROBERT, North East, Pa.
HOOVEN, MORRIS D., Newark, N. J.
HOWE, WILLIAM A., Pittsburgh, Pa.
JOHN, C. KURIEN, Sindri, Bihar, India
JOHNSON, THOMAS R., Allentown, Pa.
JONES, JOHN P., Chattanooga, Tenn.
KAHL, ROBERT LEROY, Cairo, Ill.
KAUFMAN, BORIS, Chicago, Ill.
KENNEDY, PHILIP P., Springfield, Pa.
KIRLOSKAR, CHANDRAKANT S., Poona, India
KRAMBIHN, S. MURRAY, Brooklyn, N. Y.
LAKE, ROBERT G., Scotia, N. Y.
LEAHY, JOHN J., Jr., Corona, N. Y.
LEE, WILFRED J., East Syracuse, N. Y.
LEMAY, ROBERT C., Philadelphia, Pa.
LESSER, ARTHUR, Jr., Hoboken, N. J.
LUSTIG, HANS G., Mexico, D. F., Mex.
MACDONALD, WARREN L., Los Angeles, Calif.
MARGOSSIAN, ZAVENS, Dearborn, Mich.
MATTHEWS, HAROLD, Vancouver, B. C., Can. (Rt)
MCGRUER, ALFRED E., Toronto, Ont., Can.
MILUSCHEWA, SIMA, Montclair, N. J.
MORRIS, EDWIN W., Los Angeles, Calif.
MUELLER, OLIVER, New Hope, Pa.
NAYAK, LAXMAN M., Bombay, India
NEAL, RICHARD C., Los Alamos, N. M.
OLSEN, KAI VALDEMAR, Copenhagen, Sorgenfri, Denmark
PEARCE, D. L. S., Vancouver, B. C., Can.
PALDROCK, KONSTANTIN K., San Francisco, Calif.
PETERKORD, GEORGE W., Paola, Kan.
PRATT, MORTON S., Natick, Mass. (Rt & T)
PURKEY, DON E., Pocatello, Idaho
READING, WALTER H., Sharon Hill, Pa.
RENZI, PETER N., Mt. Vernon, N. Y.
RING, JAMES H., Milwaukee, Wis.
RIOS PRUNEDA, ARMANDO, Mexico, D. F., Mex.
RISSE, JOHN T., Cedar Rapids, Iowa
ROBINSON, KENNETH O., San Francisco, Calif.
SAAVEDRA GARCIA, MIGUEL, Mexico, D. F., Mex.
SCHAEFER, ROBERT L., Port Lavaca, Texas
SCHUDER, C. B., Metropolis, Ill.
SEEL, PAUL M., Bala-Cynwyd, Pa.
SHARPE, ROBERT Q., New York, N. Y.
SHEA, THOMAS M., Colmar, Pa.
SLOOTWEG, A. M. R., Colorines, Mex.
SMEDBERG, GEORGE E., Niagara Falls, N. Y.
STOROJEFF, IVAN A., San Francisco, Calif.
SWINT, LUTHER O., Greenville, Miss.
THOMASON, JAMES M., Port Lavaca, Texas
TUCK, HARVEY R., Wright-Patterson AFB, Ohio
TURNER, TOM, Buffalo, N. Y.
WAGNER, MILLARD L., Cincinnati, Ohio
WASHBURN, DONALD A., New London, Conn.
WESTERHOFF, RUSSELL P., Paterson, N. J.
WHIPPO, HARRISON M., Jr., Boulder, Colo.
WILLEY, MARNEY B., Harvey, La.
WILSON, JOHN M., Cincinnati, Ohio

CHANGE IN GRADING

Transfers to Member and Associate

ANDERSON, GOTTHARD E., New York, N. Y.
ASHBY, WILLIAM B., Philadelphia, Pa.
AVENT, JOHN S., Winston-Salem, N. C.
AVERY, JOHN R., Arlington, Va.
BETH, WALTER F., Worcester, Mass.
BLACK, JOHN T., Rumson, N. J.
BRAUBURGER, ROBERT A., Birmingham, Mich.
BRUNNER, THOMAS L., New York, N. Y.
CANAVAN, H. M., Boston, Mass.
CROFTEN, PAUL A., Washington, D. C.
DAWSON, JOHN E., Newark, Del.
ELSBACH, GERALD, Berkeley, Calif.
EMMONS, HOWARD W., Cambridge, Mass.
FEIGENBAUM, ARMAND V., Lockland, Ohio
FITCH, W. CHESTER, Camp Hill, Pa.
FONVILLE, BRYCE M., South Charleston, W. Va.
GROSSENBACHER, ERNEST, JR., Pittsfield, Mass.
HEWETT, WALTER, Loughborough, Leicestershire England
JOHNSON, WILFRID E., Richland, Wash.
MATHES, STANLEY F., Providence, R. I.
ORR, J. D., Toronto, Ont., Can.
PETTUS, R. B., N. Hollywood, Calif.
RADCLIFF, LEO L., Argo, Ill.
RICHARDSON, THOMAS, San Francisco, Calif.
SHERMAN, P. F., Pittsburgh, Pa.
WEISMANTLE, ARTHUR R., New York, N. Y.
WILLIAMS, JOHN, Caracas, Venezuela, S. A.
ZOLLI, BASIL V., Los Angeles, Calif.

Transfer from Student Member to Junior 120

Obituaries

Ernest Gregory Aitelli (1927–1951)

ERNEST G. AITELLI, industrial engineer, Newark, N. J., died Oct. 2, 1951. Born, Newark, N. J., June 11, 1927. Education, BA, Columbia University, 1949; BS(IE), 1949. Jun. ASME 1949.

Albert Harlan Bates (1869–1952)

ALBERT H. BATES, a specialist in patents, copyrights, and trademarks, had been a member of the law firm of Bates, Teare & McBean, Cleveland, Ohio, died April 26, 1952, at his home in Sheridan, Wyo. Born, Cincinnati, Ohio, Jan. 24, 1869. Parents, Dr. and Mrs Cyrus S. Bates. Education, ME, Lehigh University, 1889; LLB, Ohio State University, 1892. Jun. ASME, 1890; Mem. ASME, 1912. Survived by his wife, Kathleen; a son, Darwin S., Willoughby, Ohio; and a daughter, Mrs. Walter Diener, Sheridan, Wyo.

Robert Frances Burke (1884–1952)

ROBERT F. BURKE, president, Boiler Engineering and Supply Co., Phoenixville, Pa., died June 25, 1952. Born, Ireland, July 11, 1884. Education, graduate, National school, Ireland; ICS courses. Mem. ASME, 1921.

Frank Daugherty (1881–1952?)

FRANK DAUGHERTY, whose death was recently reported to the Society, was president, Scofield Engineering Co., consulting engineers and appraisers, Philadelphia, Pa. Born, Paris, Ky., June 9, 1881. Parents, Charles A. and Anna M. (Garrard) Daugherty. Education, BME, University of Kentucky, 1901. Married Anna Carnahan, 1917 (deceased). Jun. ASME, 1909; Mem. ASME, 1925.

Robert L. Ennis (1901–1952?)

ROBERT L. ENNIS, whose death was recently reported to the Society, was chief engineer, Nestlé's Chocolate Co., Inc., Fulton, N. Y. Born Elmira, N. Y., Oct. 20, 1901. Education, ME, University of Cincinnati, 1927. Mem. ASME, 1941.

Pehr Christian Klintman (1895–1952)

PEHR C. KLINTMAN, mechanical engineer, Nordberg Manufacturing Co., Milwaukee, Wis., died June 2, 1952. Born, Gysinge, Sweden, Aug. 22, 1895. Parents, Christian A. and Ida Klintman. Education, graduate, Chalmers Technical

(*ASME News continued on page 776*)

BETTER SAFE THAN SORRY WHEN YOU'RE MOVING GAS OR AIR

Type OIB Single-Stage Centrifugal Blower in automobile plant. Capacity 13,850 cfm.

- ☐ Choice of Rotary or Centrifugal
- ☐ Capacity matched to the job
- ☐ Easy accessibility
- ☐ Ruggedness
- ☐ Ease of installation
- ☐ Ability to handle overloads
- ☐ Long-time durability
- ☐ Freedom from breakdowns
- ☐ Low maintenance costs
- ☐ Engineering assistance
- ☐ Proved reputation of maker
- ☐ Customer satisfaction

You can't afford to take chances when production and profits depend on maintained performance of blowers, exhausters, gas pumps or related equipment. So, we suggest that you check carefully the above factors before you make your final decision.

If you are faced with a choice between Centrifugals or Rotary Positives, remember that only Roots-Connersville makes both types. From our exclusive *dual-ability line*, with capacities from 10 cfm to 100,000 cfm, at moderate pressures, most buyers can find a unit closely matched to their specific needs.

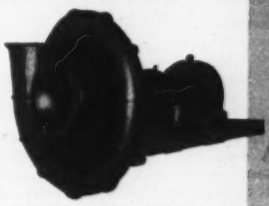
We'd like to remind you, too, that for almost a century we've built only blowers and related equipment. Our products have a long, happy record for outstanding, reliable, economical performance. Our vast reservoir of engineering experience is always at your service, to meet almost every industrial problem of moving gas or air.

ROOTS-CONNERSVILLE BLOWER CORPORATION
522 Michigan Avenue, Connersville, Indiana

Type RF-3 Rotary Positive Vacuum Pump in chemical plant. This unit replaced a 25-year-old R-C pump, partially destroyed by fire, which has been repaired for other service.

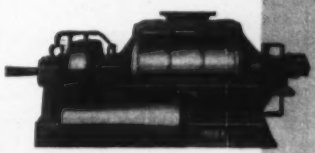
THE *DUAL-ABILITY* LINE OF MODERN EQUIPMENT TO HANDLE GAS AND AIR

Multi-Stage Centrifugal Exhausters

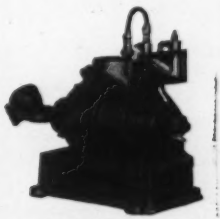


Single-Stage Centrifugal Blowers

Rotary Positive Blowers



Rotary Positive Gas Pumps



Positive Displacement Motors

Inert Gas Generators

ROOTS-CONNERSVILLE BLOWER
A DIVISION OF DRESSER INDUSTRIES, INC

Institute, Gothenburg, Sweden, 1915. Married Mary Eckels, 1926; children, Richard and Kristin. Naturalized U. S. citizen, 1940. Assoc.Mem. ASME, 1929; Mem. ASME, 1935.

Carl Henry Lambelet (1888–1952)

CARL H. LAMBELET, vice-president, American Machine and Foundry Co., died June 21, 1952. Born, Hoboken, N. J., Dec. 23, 1888. Parents, Henry A. and Louise Lambelet. Education, ME, Stevens Institute of Technology, 1911. Married Adele Keuffel, 1915 (divorced). Married 2nd, Mrs. Sadie M. Chavent. Jun. ASME, 1913. Survived by wife and two stepchildren, Mrs. John S. Pink, Anthony P. Chavent, Jr., and sister, Mrs. Lucile Rieser.

Alexander Lawson Mellanby (1871–1951)

ALEXANDER L. MELLANBY, professor, who for over 30 years held the Chair of civil and mechanical engineering, Royal Technical College, Glasgow, Scotland, died at his home at Bridge of Weir, Renfrewshire, Nov. 26, 1951. Born, Hartlepool, England, July 3, 1871. Parents, Mr. and Mrs. John Mellanby. Education, Armstrong College, Newcastle-on-Tyne; DS, McGill University, Montreal, 1896. Married Annie W. Maunder, 1901. Mem. ASME, 1926. He collaborated with the late Prof. W. C. Unwin in writing a book on the elements of machine design, and he contributed many papers to technical societies, most of them relating to the steam engine. One branch of research to which he was attracted was the flow of steam in the steam turbine and in 1920–1925 he published a notable series of papers, prepared in conjunction with Prof. W. Kerr and based on work carried out by staff and students at the Royal Technical College, in which the losses in turbine nozzles of many different designs were analyzed into their constitutents and their values estimated. In 1937 he delivered the Andrew Laing Lecture, on land and marine steam generators, before the North-East Coast Institution of Engineers and Shipbuilders, and in 1940 the Thomas Lowe Gray Lecture, on "Fifty Years of Marine Engineering," before The Institution of Mechanical Engineers. Survived by wife and two sons.

Deonicy Samuel Red (1921–1950)

DEONICY S. RED, trainee, Westinghouse Electric Corp., Pittsburgh, Pa., was killed while on active duty with the U. S. Navy, Sept. 19, 1950. Born, Mechanicsburg, Pa., Feb. 11, 1921. Education, BS(ME), Lehigh University, 1950. Jun. ASME, 1950.

John C. Reed (1902–1952)

JOHN C. REED, vice-president in charge of research, American Radiator and Standard Sanitary Corp. of Pittsburgh, died at Louisville, Ky., June 16, 1952. Born, Glenfield, Pa., May 20, 1902. Education, BS in mining engineering, The Pennsylvania State College, 1928. Mem. ASME, 1950.

Anthony Andrew Rondo (1899–1951)

ANTHONY A. RONDO, designer and engineer, Stone and Webster Engineering Corp., Boston, Mass., died Dec. 18, 1951. Born, Providence, R. I., June 26, 1899. Education, BS(ME), Rhode Island State College, 1924. He held a U. S. Patent for new improvements in aerial navigation machine. Mem. ASME, 1945.

Henry Francis Scott (1876–1952?)

HENRY F. SCOTT, whose death was recently reported to the Society, was a consultant in the development of automatic machinery and plant engineering for industrial plants. Born, Brockton, Mass., Aug. 5, 1876. Parents, George V. and Charlotte E. Scott. Education, BS, Massachusetts Institute of Technology, 1898. Married Alice G. Brown, 1900; daughters Meredith A. and Arlene C. Mem. ASME, 1907. He served the Society as a member of the Subcommittee on Care and Operation of Steam Boilers and as a member of the Executive Committee, Boston Section, 1929–1932. He was the author of several articles published in technical journals.

Walter Norman Stevenson (1881–1952)

WALTER N. STEVENSON, owner, S&S Hinge and Metal Products Co., Chicago, Ill., died June 24, 1952. Born, Derby, England, July 7, 1881. Parents, Richard W. and Anne M. (Birks) Stevenson. Education, Whitworth School, Derby, 1887–1898; University College, Nottingham, 1898–1900; engineering pupil, George Fletcher & Co., Derby, 1900–1903. Married Eleanor Cobb, 1914; children, Walter N., Jr., and Joseph A. Mem. ASME, 1921.

Albert Harry Thomas (1870–1952)

ALBERT H. THOMAS, chairman, board of directors, The Buckeye Steel Castings Co., Columbus, Ohio, died May 29, 1952. Born, Richmond, Ind., Aug. 7, 1870. Education, Earlham College; BS, Purdue University, 1895; ME, 1897. Mem. ASME, 1927.

James Lawrence Walsh (1886–1952)

COL. JAMES L. WALSH of Summit, N. J., retired Army officer, banker, and president of the American Ordnance Association, died June 11, 1952, in Walter Reed Army Hospital, Washington, D. C. Born, Boston, Mass., May 6, 1886. Parents, James L. and Rose (Raycroft) Walsh. Education, Massachusetts Institute of Technology, 1903–1905; graduate, U. S. Military Academy, 1909. Married Mazie Porcher, 1918; son, James L. (deceased). Mem. ASME, 1935. He was noted throughout the country as an industrial mobilizer. He was a Regular Army officer for 13 years including World War I service. During World War II he served as chairman of the ASME War Production Committee, as vice-chairman of the National Technological Advisory Commission, and as a special adviser to the Army Chief of Ordnance. A charter member of the Ordnance Association, and long a director, he became president in 1948. He invented a type of powder grain and helped design a disappearing carriage for what was once the world's largest gun. In 1919 he helped found the Army Ordance Association, which became the American Ordnance Association in 1948, and he was founder and editor of the Association's journal, *Army Ordnance*, and of another association publication, *Logistics*. He was a recipient of the Crozier Gold Medal for outstanding service to the cause of industrial preparedness. He held the Distinguished Service Medal and was a commander, Order of Saints Maurice and Lazarus of Italy. Survived by his wife; a brother Raycroft Walsh, Hartford, Conn.; and a sister, Rosemary Walsh, Washington.

Cecil Custer Willis (1899–1952)

CECIL C. WILLIS, superintendent of generation, Oklahoma Gas and Electric Co., Oklahoma City, Okla., died June 27, 1952. Born, Mankato, Kan., Oct. 5, 1899. Education, BS(ME), University of Kansas, 1922. Mem. ASME, 1942. He was the author of several papers published in technical journals.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult reverse side of card for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting your address, business connection, and Professional Divisions enrollment is printed on this page. Please use it to keep the master file up to date.

Four weeks are required to complete master-file changes.

ASME Master-File Information

(Not for use of student members)

Please print — **Check mailing address**

Name ..... (Last / First / Middle)

Home address ..... (Street / City / Zone / State) ☐

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Address of employer ..... (Street / City / Zone / State) ☐

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Title of position held .....

Nature of work done .....

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2 .....

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(Processing of address change requires four weeks)

I am a subscriber to (please check)

Transactions ☐ Journal of Applied Mechanics ☐ Applied Mechanics Reviews ☐

TWO TERRY TURBINES IN RECORD NON-STOP RUN AT CITIES SERVICE

After 26 Months of Continuous Operation, Cost of Replacement Parts Only $78.00 for Each Turbine

Two Terry turbines recently completed a record non-stop run at the East Chicago refinery of Cities Service Oil Company. Specially designed for driving air blowers on fluid catalytic cracking, they ran continuously *from initial start up*, day and night, for two years and two months. Throughout the entire run neither turbine suffered any noticeable reduction in efficiency.

On inspection, after shutdown, it was found that the only parts showing signs of wear were the shaft packing rings. These were replaced at a total cost of $78.00 for each turbine.

While this extremely low cost for repairs, after such a record run, could not have been anticipated, Cities Service had good reason to expect outstanding performance from Terry turbines. A four-year record of 216 Terry turbines at the Lake Charles refinery of this same company showed amazingly low maintenance costs. During this period, the yearly cost of replacement parts averaged only 1.4% of the initial investment.

The two turbines at East Chicago are rated 2450 horsepower at 5030 rpm. Each is equipped with a trip throttle valve, forced feed lubrication, and regulator for process control applied to a variable speed oil relay governor.

For more information about Terry multistage turbines, send for a copy of Bulletin S-146. No cost or obligation.

TERRY

THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN

JENKINS PRACTICAL PIPING LAYOUTS 62

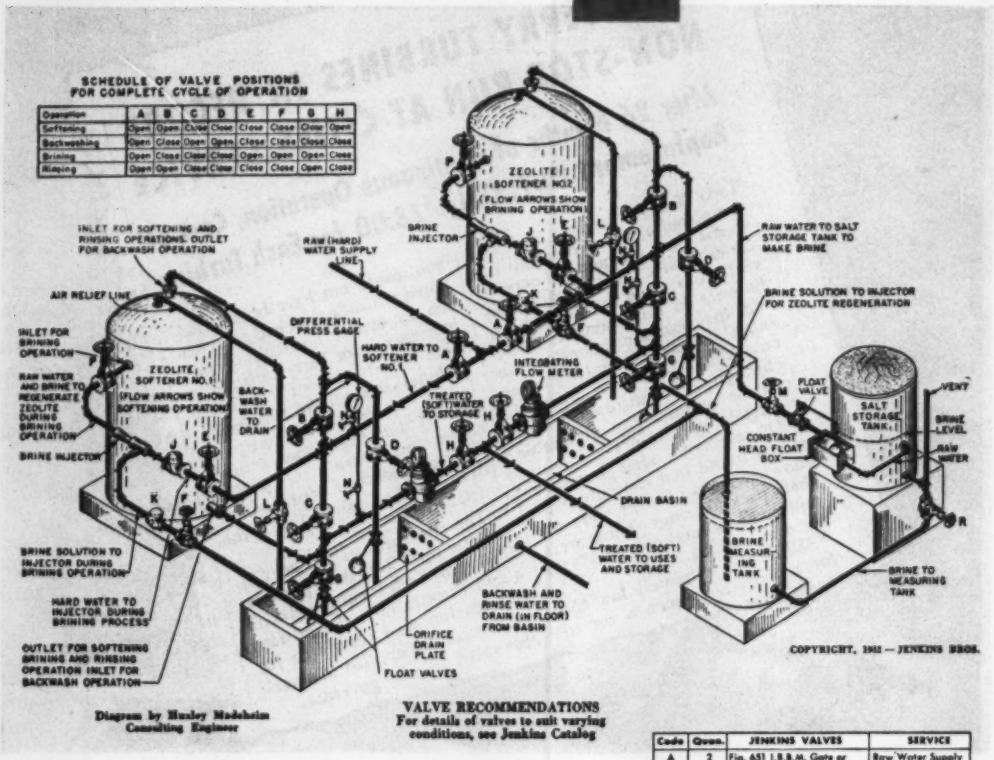

SCHEDULE OF VALVE POSITIONS FOR COMPLETE CYCLE OF OPERATION
Operation | A | B | C | D | E | F | G | H
Softening | Open | Open | Close | Close | Close | Close | Close | Open
Backwashing | Open | Close | Open | Open | Close | Close | Close | Close
Brining | Open | Close | Close | Close | Open | Open | Open | Close
Rinsing | Open | Open | Close | Close | Close | Close | Open | Close
ZEOLITE SOFTENER NO.2 (FLOW ARROWS SHOW BRINING OPERATION)
ZEOLITE SOFTENER NO.1 (FLOW ARROWS SHOW SOFTENING OPERATION)
INLET FOR SOFTENING AND RINSING OPERATIONS. OUTLET FOR BACKWASH OPERATION
AIR RELIEF LINE
INLET FOR BRINING OPERATION
RAW WATER AND BRINE TO REGENERATE ZEOLITE DURING BRINING OPERATION
BRINE INJECTOR
RAW (HARD) WATER SUPPLY LINE
DIFFERENTIAL PRESS GAGE
HARD WATER TO SOFTENER NO.1
BACK-WASH WATER TO DRAIN
TREATED (SOFT) WATER TO STORAGE
INTEGRATING FLOW METER
RAW WATER TO SALT STORAGE TANK TO MAKE BRINE
BRINE SOLUTION TO INJECTOR FOR ZEOLITE REGENERATION
FLOAT VALVE
SALT STORAGE TANK
VENT
BRINE LEVEL
RAW WATER
CONSTANT HEAD FLOAT BOX
DRAIN BASIN
TREATED (SOFT) WATER TO USES AND STORAGE
BRINE MEASURING TANK
BRINE TO MEASURING TANK
BRINE SOLUTION TO INJECTOR DURING BRINING OPERATION
HARD WATER TO INJECTOR DURING BRINING PROCESS
OUTLET FOR SOFTENING BRINING AND RINSING OPERATION INLET FOR BACKWASH OPERATION
BACKWASH AND RINSE WATER TO DRAIN (IN FLOOR) FROM BASIN
ORIFICE DRAIN PLATE
FLOAT VALVES
COPYRIGHT, 1952 — JENKINS BROS.

Diagram by Huxley Madeheim
Consulting Engineer

VALVE RECOMMENDATIONS
For details of valves to suit varying conditions, see Jenkins Catalog

Code	Quan.	JENKINS VALVES	SERVICE
A	2	Fig. 651 I.B.B.M. Gate or Fig. 100 All Iron Gate	Raw Water Supply to Softener
B	2	Fig. 651 I.B.B.M. Gate or Fig. 100 All Iron Gate	Control of Cycle Operations
C	2	Fig. 651 I.B.B.M. Gate or Fig. 100 All Iron Gate	Control of Cycle Operations
D	2	Fig. 651 I.B.B.M. Gate or Fig. 100 All Iron Gate	Backwash Drain Line
E	2	Fig. 100 All Iron Gate	Injector Water Shutoff
F	2	Fig. 40-A All Iron Gate	Brine Control to Injector
G	2	Fig. 651 I.B.B.M. Gate	Brine and Rinsing Operation Drain
H	2	Fig. 651 I.B.B.M. Gate	Softened Water Shutoff
J	2	Fig. 624 I.B. Swing Check or Fig. 85 All Iron Swing Gate	Prevent Backflow
K	2	Fig. 623 I.B. Swing Check or Fig. 85 All Iron Swing Gate	Prevent Backflow
L	2	Fig. 106-A Bronze Globe	Air Release
M	1	Fig. 106-A Bronze Globe	Water Supply for Brine
N	4	Fig. 743-G Bronze Needle	Pressure Gage Control
P	2	Fig. 100 All Iron Gate	Brine Connection Shutoff at Softener
R	1	Fig. 40-A All Iron Gate	Brine to Measuring Tank

How to plan a ZEOLITE (BASE EXCHANGE) WATER SOFTENING SYSTEM

Diagram shows piping connections for a zeolite water softening system (removal of hard water impurities). Twin softening units permit one to operate while the other is being regenerated, (replacing used sodium in the zeolite).

The complete cycle consists of softening, backwashing, brining, and rinsing. After a certain amount of raw water has been softened, the sodium in the zeolite is used up. The process is then stopped by operating the valves as indicated in the schedule, and the other softening unit is put into operation.

The zeolite is regenerated, after the backwash operation (first step in regeneration of softener), by replacing accumulated calcium and magnesium with the sodium by running through a brine solution. The zeolite is then rinsed after correct amount of brine solution has been admitted.

The rinsing operation also removes any remaining brine, making the softener ready for re-use when needed. Depending upon the chemical composition of the water, either iron-body bronze-mounted or all-iron valves are recommended on all lines conducting the water before it is completely treated.

Consultation with piping engineers is recommended when planning any major piping installations.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering, select all the valves you need from Jenkins complete line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17.

Complete description and enlarged diagram of this layout free on request. Includes additional detailed information. Simply ask for Piping Layout No. 62.

JENKINS VALVES
LOOK FOR THE DIAMOND MARK
Jenkins Bros.

Keep Informed

ANNOUNCEMENTS OBTAINED MOSTLY FROM ADVERTISERS IN MECHANICAL ENGINEERING AND ASME MECHANICAL CATALOG

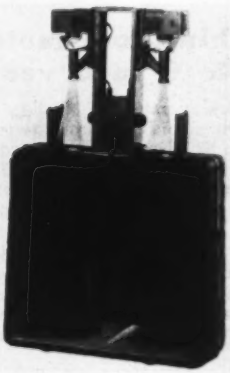
New Equipment *Business Notes* *Latest Catalogs*

Available literature or information may be secured by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

New Equipment

Surface Comparator

Greater flexibility in use, increased portability, and more pleasing appearance are the features of the new Faxfilm surface comparator, Model BL-122, now being introduced by The Brush Development Co. Faxfilm is the method of surface study in which a clear plastic replica of a surface is made in about a minute and projected in a microprojector to show minute details of surface condition with marked three-dimensional effect.



The new Faxfilm surface comparator provides comparison projection of two Faxfilm replicas at 30 diam magnification. Its principal uses include comparison of work specimens with standard finishes in surface roughness inspection, the comparison of finishes obtained in machinability studies, and comparisons of surface changes in wear and life tests.

The new BL-122 surface comparator is 25 × 12 in. at the base and 22 ½ in. high. Including an accessory and file case, carried in the base of the unit, total weight is less than 30 lb, a reduction of 30% from the Model BL-121 which it replaces. The unit has pleasing, modern design in a warm, maroon synthetic material which combines lightness and unusual strength. The specially designed Faxfilm Micro-Projectors use Wollensak 1 in. f:1.9 projection lenses.

For travel use, when comparison projection is not required, one projector may be removed from the large unit and carried in the small accessory case. This would provide a complete unit—materials, working area, file tray, screen, and projector—in an 11½ × 10 × 4 in. case, total weight less than 8 lb that could be carried in a suitcase.

A detailed description of the new surface comparator may be obtained from the Brush Development Co., Instrument Div., 34G, 3405 Perkins Ave., Cleveland 14, Ohio.

Power Line Air Blasters

A heavy duty, high velocity air blaster for industrial applications for foundries, kilns, pipe bending operations, and for shipboard use. Portable—can be moved by hand or by crane. Totally enclosed ball bearing motor, direct drive. Cast aluminum, nonoverloading airfoil propeller, protected by heavy mesh wire guards at both ends. Will operate with flexible canvas tubing and where static pressure is encountered. Can be used as exhauster or blower. Rugged construction and will stand abuse. Sizes 18 to 42 in., 6600 to 34,000 cfm. Also available in floor mounting without stand, Type PLDU. Request bulletin 406-A.

Air delivery ratings are determined by the standard test code of the Propeller Fan Manufactueres' Association and the American Society of Heating and Ventilating Engineers.

These fans are a product of Chelsea Fan & Blower Co., Inc., Plainfield, N. J.

Tachometer Kits

New tachometer kits, containing all the components necessary to provide instantaneous and permanent records of machine performance at a central location, have been announced by the General Electric Company's Meter and Instrument Dept., Schenectady, N. Y.

Central location of the new kits' recording equipment eliminates time-consuming production-line trips by supervisory personnel, permitting up-to-the minute checks of operating equipment. Permanent recording feature aids preventive maintenance scheduling, and prevents excessive manufacturing losses by automatically shutting down machinery in case of breakdowns.

Four kits are available in the new line. A typical installation would include a d-c tachometer generator, a tachometer indicator, a switchboard-type tachometer recorder, and (where a continuous web of material is produced) a web-break detector. Audible or visual alarm systems are optional accessories.

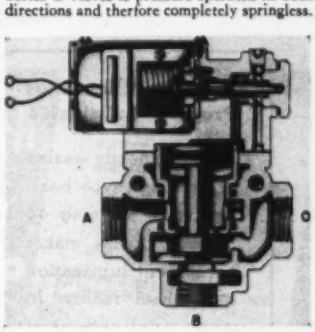
Kits are particularly suited for use in the continuous process industries such as paper, textile, rubber, glass, and steel and aluminum rolling.

A bulletin GEC-816, available from the General Electric Co., Schenectady 5, N. Y., describes the kits.

Air Control Valve

A special feature of their new P-M line of "Pilot-Master" valves, recently announced by Hannifin Corp., 1140 South Kilbourn Ave., Chicago 24, Ill., is a 3-way solenoid Pilot-Master valve for expecially hazardous applications, so designed that it "fails safe" under all conditions. Its principal use is expected to be for the control of clutch and brake cylinders on mechanical presses, where the failure of a valve to reverse when the solinoid is de-energized might result in serious injury to the press operator.

Called the Series B-3, the new valve differs from the "standard" Series B-2 Solenoid Pilot-Master valve in that Hannifin engineers have taken advantage of the fact that the main or "master" valve portion of all Series B valves is pressure-operated in both directions and therfore completely springless.



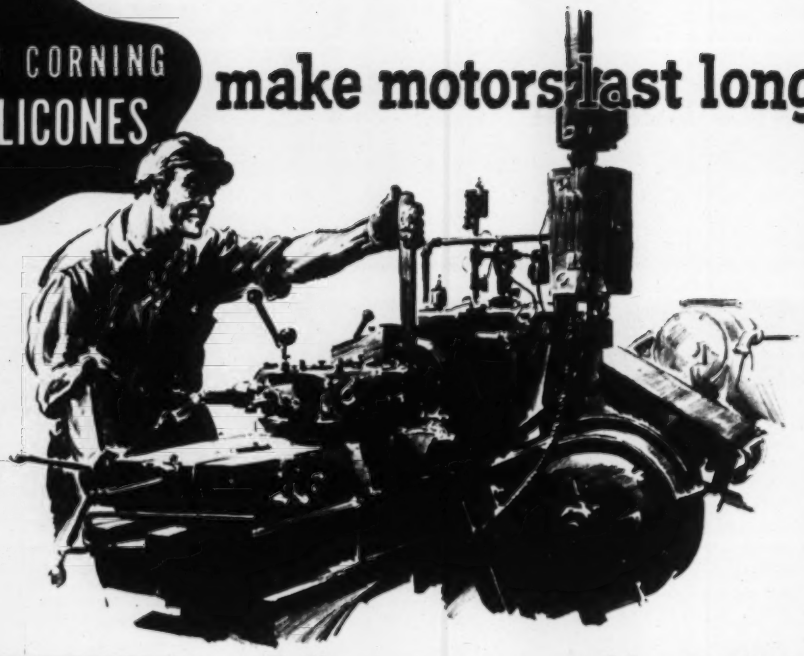
By applying the same principle of exposing differential areas to pressure to the design of the pilot head mechanism, they have provided a completely springless valve assembly in which both "pilot" and "master" valves are automatically returned to the "normal" or inoperative position by air pressure the instant the solenoid is de-energized. Since retained air in the brake and clutch cylinders of the press would have sufficient pressure to operate the valve even in case of a break or a serious leak in the air line, there is no conceivable situation in which the press would not be stopped, not even the simultaneous loss of both voltage and air supply.

The possibility that the valve itself might jam, due to spreading laminations in the plunger of the solenoid, is provided against by the special design of the solenoids used, not only in this valve but in every solenoid valve in the Pilot-Master line. The transformer-type silicon iron plunger has an anvil of hardened tool steel welded across the entire plunger face so the laminations can never spread.

The main or master valve can be operated either 2-way or 3-way, normally closed to

DOW CORNING SILICONES

make motors last longer



Failure rate on machine tool motors cut from 1 a month to 0 in 2 years!

In a line of 20 turret lathes, piece-work operators at Mueller, Ltd., Sarnia, Ontario, were burning-up drive motors at an average rate of one a month. These lathes were driven by Class B motors, rated at 5 hp at 650 rpm and subjected to 1200 full reversals an hour. Under such operating conditions, 18 replacement motors had to be carried in stock; occasionally all 18 of the spares were called upon to maintain production.

Two years ago, 25 of these motors were rewound with Silicone (Class H) insulation by Canadian Westinghouse Company. Twenty of them have been in service ever since. The 5 replacement motors are still standing by, in spite of the fact that some of the more ambitious operators took the overload capacity of these Class H motors as a personal challenge.

That kind of life and overload capacity, demonstrated in thousands of applications, proves the economy of Class H insulation made with Dow Corning silicones. Capable of putting out 50% more power than their name-plate rating, Class H insulated motors have 10 to 100 times the life expectancy of the next best class of motors under comparable service conditions.

Ask your motor supplier or rewind shop about Silicone (Class H) insulation or write direct to Dow Corning Corporation, Midland, Mich.

Keep Ball Bearings Properly Lubricated

In permanently sealed or cartridge type bearings, Dow Corning 44 Silicone grease makes permanent lubrication a practical reality. In many applications it outlasts the best organic lubricants 10 to 1 in either open or shielded bearings.

mail this coupon *Today*

Dow Corning Corp., Dept. Q-21 Midland, Mich.
Please send me:
- ☐ Catalog of Class H Insulating Materials.
- ☐ List of Class H motor repair shops.
- ☐ Data on Silicone Grease for motor bearings.
- ☐ 32-page booklet entitled "What's A Silicone?"

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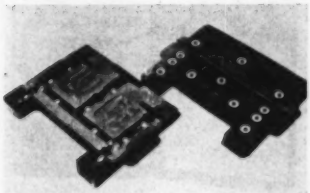
In Canada: Fiberglas Canada Ltd., Toronto • In England: Midland Silicones Ltd., London

pressure or normally open, just as with the B-2 Series valve. The only difference is that the solenoid has to be a little stronger, to overcome the differential pressure within the pilot valve. Also, the recommended pressure range is from 40 to 125 psi (instead of 15 to 150 psi), in order to keep differential pressure on the pilot valve stem within the design range. The Series B-3 has all the maintenance advantages of the Series B-2, including a replaceable cartridge containing every moving part of the main or "master" valve. The solenoid can be completely disassembled, and coils for 115, 230, or 460 volts and for either 25 or 50/60 cycles are all available as standard. One size of pilot head fits all five sizes of master valve from 3/8 in. through 1 1/4 in IPS.

Nylon Core-Box Bushings

By inserting nylon bushings at the core-box flow holes, and nylon striker pads at the spots of greatest wear in the mold cavity, a mid-west foundry has kept the core box in service "several times" longer than usual without repair or replacement.

The company uses aluminum core boxes for molding sand cores used in casting brass valves and plumbing fittings. When the two halves of the core box are put together, core sand mixture is forced into the box through the blow holes in the upper half under air pressures of from 80 to 120 lb. The abra-



sive action of the sand soon wears the unprotected metal at and around the holes, and also at spots in the cavity directly below the the holes, where the sand hits with terrific pressure.

The nylon plugs and bushings resist the abrasive action of the sand. They are machined from FM-10001 nylon rod provided by The Polymer Corp. of Pennsylvania, Reading, Pa. It is said that nylon is much more effective than rubber inserts, formerly used, and has almost entirely eliminated the difficulties encountered from sand abrasion.

Automatic Control System

Production of an electronic cycling system for the automatic control of electromagnetic vibration exciters has been announced by The MB Mfg. Co., Inc., New Haven 11, Conn. It is said to be the only equipment of its kind, and is claimed to exceed the performance requirements of Specification MIL-E-5272 for automatically cycled vibration testing.

This MB equipment is identified as Model ACS-25 and has up to 500 cps range. It provides for rapid and accurate setting up of desired constant displacement or acceleration of the shaker table. Programming tests for variable displacement or acceleration can be accommodated. Several control conditions are said to be obtainable by simple switching. (1) Automatic control of fre-

di-acro PUNCH
NEW DOUBLE PURPOSE PRESS

Available in two sizes, 6" and 12" throat depth

Now you can punch holes of various shapes as large as 4" diameter in 16 gauge steel—also blank, draw, emboss, form—all with the new DI-ACRO Punch. It is ideal for both experimental and production work.

The precision ground triangular ram of this double purpose press prevents punch head from turning, assuring perfect alignment at all times for accuracy in duplicated parts.

A Turret Stripper of exclusive DI-ACRO design automatically strips material from punches of all shapes. Roller Bearing cam action develops 4-ton pressure with minimum effort. Adjustable gauges assure exact location of holes.

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Gives the full story of the DI-ACRO Punch, and also DI-ACRO Benders, Brakes, Shears, Rod Parters, Notchers, as well as the new DI-ACRO Vari-O-Speed Powershear and Hydra-Power Bender.

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• Longer Life
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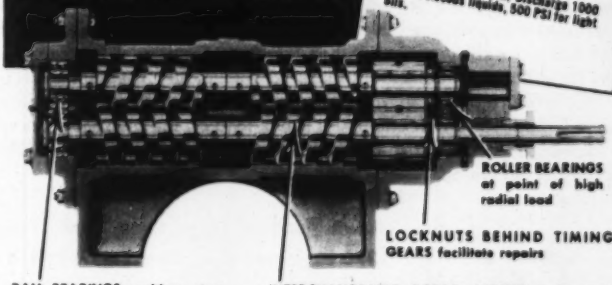
Capacities 1-700 GPM; Discharge 1000 PSI for viscous liquids, 500 PSI for light oils.



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LOCKNUTS BEHIND TIMING GEARS facilitate repairs

BALL BEARINGS position rotors axially for less wear on bearings and timing gears

INTERCHANGEABLE ROTOR SCREWS make major overhauls simple, inexpensive—greatly reduce need (and expense) of periodic pump replacement

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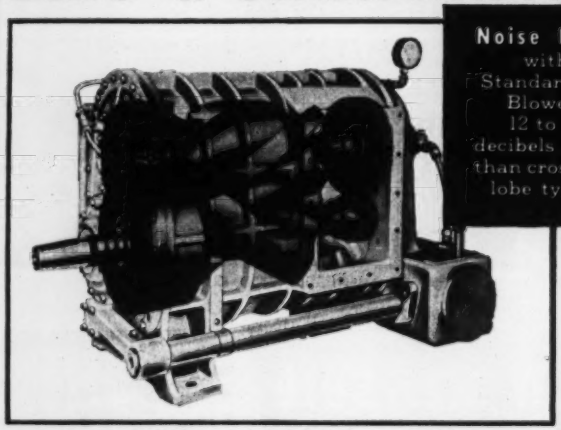
Also Manufacturers of "Gearex" Pumps, Precision Gears and Flexible Gear Couplings

MUST BLOWERS BE LOUD OR QUIET Like a STANDARDAIRE



Noise Level with Standardaire Blowers 12 to 18 decibels lower than crossflow lobe types.

STANDARDAIRE QUIETNESS MEANS LESS WEAR--MORE AIR

IMPARTIAL tests have proved conclusively that Standardaire Blowers with their smooth, gradual delivery action minimize shock and sound pulsations . . . a distinct contribution to quiet operation. Then too, the noise level does not noticeably increase with higher pressures. With the Standardaire principle you squeeze the air gently instead of slapping it . . . a feature that eliminates shock load on the internal parts of the blower. This, of course, means less wear and prolongs service life, even under severe operating conditions.

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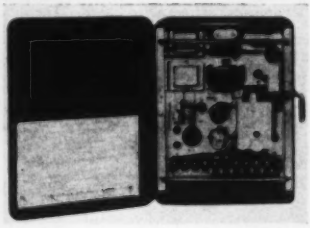
quency variation and acceleration or amplitude. (2) Automatic amplitude or acceleration control, manual frequency variation.

For MIL-E-5272 Specification, the system holds displacement constant through 10-55-10 cps repeated in one-minute cycles; it also provides continuous sweeps over 10-500 cps in 15 min cycles, holding constant displacement between 10 and 75 cps and constant acceleration between 75 and 500 cps. Both are done automatically. According to the manufacturer, the ACS-25 system is now available in the control panel furnished with the MB Models C-5 and C-25 (2-500 cps) Vibration Exciters.

Gas, Oil Burner Programming Control

Fireye programming control type 26RJ8 announced by Combustion Control Corp., 77 Broadway, Cambridge 42, Mass., is designed to provide automatic starting and programming control for commercial and industrial gas, oil, and combination gas/oil burner equipment. It is used with the new Firetron scanner type 48PT1 to protect burner installations from the hazard of flame failure. The control automatically starts a burner in operation and programs a sequence of prepurge, ignition-on, fuel valve delay, postignition timing, and postpurge.



Programming control type 26RJ8 incorporates many unique design features. Its instantaneous response to flame failure results in complete fuel cut-off in 2 to 4 sec, providing the absolute maximum of protection from explosion hazards. A built-in time delay prevents false shutdown from transient effects such as smoky streaks in the flame or irregular draft conditions. Timing is accomplished through a high torque synchronous motor, insuring positive, accurate sequencing. All contact assemblies make use of oversize contacts and operate with snap action. Cam assembly construction permits programming variations to meet the needs of every type of automatic burner.

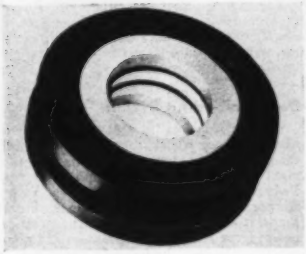
The control is designed to provide continuous operation under the most exacting ambient conditions to be encountered on industrial installations and bears the labels of Underwriters' Laboratories Inc., and Factory Mutual Laboratories. It features fail-safe circuits through which component failure within the equipment causes instantaneous shutdown and prevents start-up under any unsafe condition within the entire burner system. Terminal connections are available for directly handling flame failure alarm and modulating motor. Plug-in construction of the chassis provides for simplified replacement and maximum accessibility for examination or adjustment. The control is rugged in design, built to withstand vibration, and is simple to install.

Flexible Couplings

The United States Gasket Co., Fluorocarbon Products Div., Camden, N.J., have announced a new adaptation of the Teflon bellows as used in their expansion joints, widely used in chemical piping.

The Chemiseal flexible coupling is composed of a bellows with only 2 convolutions, assembled with flanges of either cast iron, aluminum, or special metals, and embodying integral Gaskets.

These flexible couplings are suitable for connection to any of the major manufacturers flanged-end designs of piping. Not only are these units suitable for joining piping of equal material, but also for joining such materials as Pyrex piping to glass-lined steel, and glass-lined steel tube to Karbate, Haveg, and steel pipe. These couplings also make the use of adapters unnecessary, eliminating the need for slip joints, and taking the place of gaskets at the point of use.



Chemiseal flexible couplings are advantageous in absorbing vibration between pumps and piping; to compensate for slight misalignments of piping and equipment outlets; to accomodate slight movement of piping when connecting to scale tanks and weighing devices; to absorb a minimum degree of axial thermal expansion.

Made of Teflon these flexible couplings are completely impervious to all chemicals excepting molten sodium and fluorine. In connection with expensive corrosion-resistant piping, (materials that are unusually low in impact strength) they act as insurance against fracture for these materials.

The allowable pressures for Chemiseal flexible couplings are conditioned on the fluid gas or vapor to be handled and temperatures involved. However, experience shows that pressures considerably in excess of those heretofore possible with Teflon Expansion Joints may be handled with safety.

Syncrogear Motor Movie

A new movie in color and sound featuring the development and application of internally geared electrical motors has been produced by U. S. Electrical Motors Inc. Its appeal is targeted at electrical and maintenance engineers who are desirous of learning how best to apply geared power and to fully understand the design and characteristics of motors in the geared classifications. It is an intensely interesting presentation with dramatic close-ups of U. S. Syncrogear Motors under construction and installed for numerous applications. A showing of this 20-min film can be arranged by writing to U. S. Electrical Motors Inc., Box 2058, Los Angeles, Calif.

under the twists and shocks of mighty hammer blows

WINSMITH SPEED REDUCERS

stand up indefinitely on Brosius Auto-Floor Manipulators

● The rugged job of gripping, lifting, tilting, manipulating tons of hot stock through forging operations and of loading or drawing furnaces — such extreme service conditions subject Brosius Auto-Floor Manipulators to a terrific beating. And day after day they take it and like it, and roll back for more!

For very good reasons, Salem-Brosius, Inc., the manufacturer, is a consistent user of Winsmith Speed Reducers for rotation of tongs heads at 22 to 24 rpm on capacities up to two tons. First, they stand up to the twist and shock of forging operations which are imparted to the spindle and transferred through the speed reducer. Second, they are compact, and being forward of the operator they do not obstruct his view of work being done.

The Winsmith (pat.) Differential Gear Reducer used on the Brosius Manipulator is unique among speed reducers. With it, in one single stage in the same housing, reduction ratios of 1.1:1 to 50,000:1 are obtained smoothly and silently — without need of extra parts.

Good to remember: within the range of 1/100 to 85 hp, Winsmith's four basic speed reducer designs — differential, worm gear, helical gear and worm-helical — provide the most complete line available from any one manufacturer.

Write for informative catalog No. 148.

WINSMITH, Inc.

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AIRCRAFT HYDRAULIC PUMPS

Model AP3V
Variable Volume

Faster, farther, higher, and safer . . .

As new records are set almost daily in every phase of aircraft performance, more and more responsibility falls to those who make operating components for these planes. Additional power, speed, precision, control and dependability must be built into smaller and lighter-weight units wherever possible.

The aircraft pump shown above is an example of how, through intensified research, Denison's long, specialized experience in hydraulics is applied to the job of keeping ahead of these ever-growing demands. This 3000 psi, compensator controlled pump, rated at 3 gpm at 1500 rpm, features excellent suction characteristics . . . extremely high over-all efficiency . . . and rugged, compact dependability that simplifies the designer's problems.

We are interested in any opportunity to help with your requirements for high pressure aircraft pumps and pressure controls. We will gladly send you complete specifications upon request. Also, if one of our specially qualified engineers can be of help to you, just let us know. Write today.

Other Denison aircraft components for circuit needs up to 5000 psi include Constant Volume Pumps . . . Relief Valves . . . and Surge Damping Valves that prevent damaging pressure shock.

DENISON Hydr OIL ics

The DENISON Engineering Co. 1189 Dublin Road Columbus 16, Ohio

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Motor Speed Control

A ¾-hp variac® motor speed control has been developed by General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Designed for light production work where a ¾-hp motor is used, this control uses no electronic tubes and so takes no warm-up time. Instant starting and reversing are provided together with strong dynamic braking.

Production time is saved when this control is used. Typical applications are on lathes, for instance, where several operations are done on the same piece at different optimum speeds; or for operations such as blind tapping where gradual starting and stopping is desired.

The compound-wound motor used with the variac speed control has much better starting characteristics than the usual induction motor, and so starts faster and heats up less under repeated starts, stops, or reversals.

The construction and circuit are similar to that used in earlier smaller controls. A single, relatively small unit, in addition to the motor, contains all parts, and is arranged for simple installation.

Dock Unloading System

Coal transported in river barges direct from mines or river-rail terminals will feed the giant boilers of an $88-million generating plant being built along the Ohio River near Paducah, Ky., by the Tennessee Valley Authority. Named the Shawnee Steam Plant, it will furnish about half the electrical power for a $500-million Uranium-253 plant of the Atomic Energy Commission at Paducah.

Contracts for construction of a dock occupying some 2180 ft along the river, and a coal barge unloading system, have been awarded by TVA to Dravo Corp., Pittsburgh, Pa.

The Contracting Division of Dravo will construct a total of 22 steel sheet pile cells for the dock. Two of them, 45 ft in diam each, will serve as foundation for the coal unloading tower and surge hopper. Three 40-ft-diam cells at the upstream end of the harbor will be ice breakers. These serve to protect the fleet of barges in high water periods. Three other cells, 20 ft in diam, are designed to support barge-shifter sheaves. The remaining 14 cells, each 16 ft in diam, will be used to moor barges. The spacing of cells varies from 85 ft to 175 ft. A continuous walkway connects most of these cells.

When completed, the harbor will have facilities for 12 loaded and 12 empty 195-ft coal barges.

The barge unloader, to be fabricated by Dravo's Engineering Works Div., consists of a 93-ft-high structural steel tower, 29 ft sq, to be mounted on one of the cells. A steel truss boom will extend out 54 ft over the water from the tower to carry a 9-ton capacity unloader bucket.

Allowing for barge shifting and other necessary functions, the equipment will unload approximately 600 tons of coal an hour.

Coal is to be dumped into a hopper in the base of the tower from where it is carried by conveyer belt some 250 ft to a surge hopper which will be constructed on another 45-ft-diam cell. A conveyer belt then will move the fuel from the surge hopper 2630 ft to the steam plant's coal-crushing building.

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NEW EQUIPMENT
BUSINESS NOTES
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Fluid Couplings

Here's an example of how fluid couplings are solving conveyer problems in the food industry.

Moving 1,400,000 lb of sugar up a continuous bucket conveyer every eight hours was creating a maintenance problem for the American Sugar Refining Co. of Baltimore—until a Twin Disc Hydraulic Coupling was installed on the conveyer motor.

Heavy vibration and excessive starting torque—the raw sugar collects moisture and presents a multiton starting load—were constantly causing shutdowns. Maintenance costs were high. Twin Disc's hydraulic dealer—Curtin Engine & Equipment Co., Inc., of Baltimore, suggested replacing the original 20-hp motor with a 15-hp unit, and installing the 17.5-in. Twin Disc Hydraulic Coupling.

The fluid "slip" provided by the Twin Disc Coupling cushioned out the vibration and shocks and permitted a soft, balanced start of the heavy torque load. The concern reports complete elimination of motor and transmission troubles due to vibration or overloading.

Descriptive installation reports on solution of shock load problems in various kinds of applications are available from the 67 Twin Disc Hydraulic Dealers, or from the Twin Disc Clutch Co., Racine, Wis., or Rockford, Ill.

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A good book to consult for authorized definitions of approximately 500 occupational specialties in engineering.

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IT'S A MATTER OF RECORD

Pacific's designs provide the balanced proportions that insure mechanical strength . . . the simplicity of form that insures hydraulic efficiency . . . material efficiency . . . easy maintenance.

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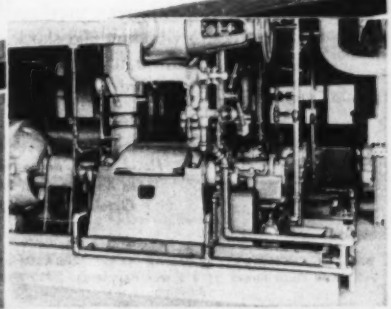
Pacific Single Stage TURBOPUMPS are built for capacities to 1000 G.P.M. . . . Discharge Pressures to 1800 psig . . . Speeds to 10,000 R.P.M. . . . Bulletin 118 for details



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NEW LORD TURBO MOUNTINGS

To Isolate Vibration of 22,000 Shaft Horsepower

This is the world's first turboprop water-based aircraft (U.S. Navy) flying over San Diego bay. The vibration of 22,000 Shaft Horsepower, the contra-rotating propellers and the gear boxes is isolated from the airframe through the use of 6 Lord Mountings on each of the 4 gear boxes.

Each of the 4 dual engines is also Lord Mounted.

The Navy's new P5Y water-based aircraft is used for long range search-rescue and anti-submarine patrol missions. The world's first turboprop water-based aircraft is equipped with the world's first Lord turbo power plant mounting . . . a typical example of the manner in which Lord experience and research serves manufacturers of aircraft. Lord Engineering capabilities team up with precision manufacture to protect aircraft, to lengthen engine life, to increase crew comfort and alertness by isolating destructive vibration and shock. Regardless of the industry in which you are battling with vibration and shock, it will pay you to call in Lord Engineers.

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Hotel Statler, Booth No. 26
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LORD — MOUNTED RUBBER

HEADQUARTERS FOR VIBRATION CONTROL

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Copying Machine

A revolutonary machine, the Copyflex Model 14, has been announced by the Charles Bruning Co., Inc., Teterboro, N. J., as management's newest tool for reducing paperwork costs throughout business.

The Copyflex 14 is the first desk-side machine to copy—in seconds— any size office form. With it, business and industry can achieve unprecedented efficiency in speeding orders, invoices, production control, accounting, sales control, purchasing, personnel work, and numerous other vital procedures.

Virtually automatic in operation, the new machine makes low-cost errorproof, smudgeproof, positive copies of practically anthing typed, written, printed, or drawn. It has a radically large copying width—20 in., enabling it to copy even the bigger accounting and statistical sheets, or ordinary letter-size forms two at a time.

The Copyflex 14, because of its high speed and 20-in. copying width, produces thousands and thousands of different-size copies daily. The cost averages less than 2¢ per sq ft of copy, including machine depreciation, operator's salary, floor space, material used, and all other charges. It usually is the most economical way to quickly make 1 to 100 copies of any one original.

The Copyflex 14 is practically soundless, and needs no masters, inks, tray developing, special lighting, exhaust ducts, or installation. It takes up less than a square yard of floor space and can be rolled on its casters to any worksite where it requires only a connection to a standard 115-volt, 60-cycle, a-c power circuit.

X-Ray Diffraction Unit

A compact, new x-ray diffraction unit, known as the XRD-4, designed for film technics only, is announced by the X-Ray Dept., General Electric Co., Milwaukee, Wis.

Requiring about half the floor space taken by the all-purpose unit, the XRD-3, the new apparatus provides an x-ray source for all x-ray diffraction film technics.

The high voltage transformer provides full-wave rectified, end-grounded voltage up to 50 kvp at 50 ma continuously. The tube current stabilizer is an instantaneous electronic control which holds the tube current constant within ± 0.02% or better.

The housing provides for mounting and electronic line-voltage stabilizer if desired as an accessory.

Height of the target of the CA-7 x-ray tube is nominally 10.5 in., but is fully adjustable from 8 to 13 in. above the top. The camera track can be adjusted from 0 to 10 deg below horizontal for optimum target takeoff angle, and from 0 to 45 deg above horizontal for use of crystal monochromators.

The focal spot in the CA-7 tube is about 1 in. from the end of the tube and the pure beryllium windows, and is longer and narrower than in other crystal analysis tubes. This proves higher intensity through collimators, and, on small samples, produces highly resolved diffraction effects.

The large, unobstructed top of the new unit gives complete freedom for mounting of up to three cameras.

The unit has a self-contained water cooler which eliminates plumbing and solves the problem of condensation, hard-water deposits, sediment deposits, and scale obstructions, which are inherent in tap-water cooling.

Automatic ProtectoSpray

Fighting fires at the molecular level by diluting the active ingredients of flame, Grinnell's new automatic ProtectoSpray gives quicker extinguishment of fires. When used in place of standard automatic sprinklers for special hazard protection such as high piled tire storage, it is said to reduce ceiling scorching and checks fire spread with 30% less water.

Years of patient research in the Grinnell Fire Control Research Laboratories, Providence, R. I., have developed this new weapon against fire in hazardous storage and volatile materials. When studies of the nature of flame showed that it results from high velocity collisions between molecules of oxygen, which make up 21% of air, and molecules of hydrocarbon in gases distilled from burning material, a method of controlling flame became obvious. Simply dilute both the oxygen and the hydrocarbons with water vapor until the mixture is too lean to burn. When heated oxygen collides with heated hydrocarbon molecules more heat is released. By interposing inert water vapor molecules between oxygen and hydrocarbons, collisions are prevented and the flame is extinguished.

The heat from a fire normally raises the temperature of near-by flammable material to its distillation and ignition temperatures. The automatic ProtectoSpray diverts this heat to vaporize water droplets. This removal of heat checks the spread of fire and the resulting water vapor dilutes the flame gases so that they cannot burn. Producing a wide range of water droplet sizes, small ones to produce water vapor and larger ones to wet and cool the burning material, the Grinnell Automatic ProtectoSpray is a new and more effective weapon against fire. It is approved by both the Factory Mutual Laboratories and the Underwriters Laboratories.

Engine-Driven Welder

A new lightweight, compact engine-driven welder (Type EW-20) is available from the Westinghouse Electric Corp., Pittsburgh 30, Pa. Equipped with complete engine accessories and auxiliary apparatus, the new welder also can supply 110-volt, 60-cycle, single-phase power from a conventional plug-in outlet.

Nominal rating of the welder is 200 amp, 40 volts, 60% duty cycle with current range from 40 to 250 amp in accordance with

SPECIALLY DESIGNED
for
EASIER INSTALLATION
and
LONGER SERVICE

Fig. 0611, IB&M Wedge Gate Valve, Working Pressures: 125 lbs. Steam, 200 lbs. WOG.

KENNEDY JOB-FITTED
Iron-Body Wedge Gate Valves

YOU SAVE TIME AND MONEY all along the line with Kennedy iron-body wedge gate valves because they are JOB-FITTED . . . every valve specially designed and engineered for the job it has to do.

THE WEDGE DISC is a cored casting of thick metal section, reinforced by integrally-cast interior posts and provided with openings to drain in any position.

HEAVY BRONZE DISC RINGS are forced into dovetailed grooves in the disc in a practically inseparable construction.

HIGHER STRENGTH IRON in the body and bonnet is actually 50% stronger than ordinary cast iron . . . and far exceeds A.S.T.M. requirements.

ALL CONTACT SURFACES between moving parts are bronze-to-bronze to assure easy operation.

RUSTPROOFED STEEL BOLTS AND NUTS have ample clearance to prevent distortion. Open-end wrenches may be used . . . no need for special tools. Valves can be repacked under full pressure.

EVERY FEATURE of the valve helps it do the job better . . . gives you a solid guarantee of economy and dependability whenever you install one of these Kennedy Job-Fitted Wedge Gate Valves.

BUY FROM YOUR LOCAL DISTRIBUTOR

WRITE FOR BULLETIN 107

THE KENNEDY
VALVE MFG. CO. • ELMIRA, N.Y.
Est. 1877
VALVES • PIPE FITTINGS • FIRE HYDRANTS

Make This Date NOW!

. . . for YOUR Benefit

MEMO

Don't Say It — Write It

Miss M—

Make no appointments for me Dec. 1-6. I'll be attending the National Power Show in New York. That Harrison deal can wait, and so can anything else. Seeing the Power Show is always a must.

P.S. Expect to take Joe and Bill along.

J.B.

Anyone concerned with steam, electric, or mechanical power problems can benefit greatly by attending this outstanding Exposition. Concentrated here will be interesting displays and informative demonstrations on . . .

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No where else can you see and compare so many things of vital interest to you and your company . . . in so little time.

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will be represented by technical men on hand to show you the latest equipment, materials, and methods for power production, distribution and use, and to help solve your present problems and future requirements. Yes, a wealth of NEW IDEAS awaits you at the

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National Exposition of
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NEMA standards. During off-welding periods, auxiliary power of 3 kw at 100% power factor or 2 kva at 80% power factor are available for lights and power tools. During welding periods about 300 watts auxiliary power is available for lights.

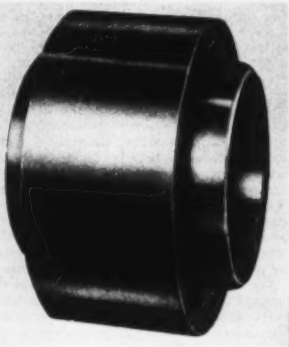
Coupled to a Ford "120", 4-cycle, 4-cylinder water-cooled industrial power unit, the self-excited, compound-wound generator functions both as a d-c generator and a single-phase alternator for auxiliary power. Welding current is controlled in four ranges by a tap switch and shunt field rheostat. The a-c power circuit includes conventional outlets, a voltmeter, and a breaker with overload protection.

For portability, two-wheel running gear suitable for high-speed road towing is available.

Flexible Couplings

A line of Cone-Drive Standard Bore couplings for Cone-Drive worm shafts, Cone-Drive gear shafts, and electric motor shafts is announced by Cone-Drive Gears Div., Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich.

Cone-Drive flexible couplings are a gear type with seven parts: a sleeve, two hubs, two neoprene seals, and two snap rings. This design is easily disassembled and is sealed to keep weather out and lubrication in. The hubs and sleeve are SAE 1045 steel



forgings with 90,000 psi tensile strength. The couplings allow an average of 3 deg. angular misalignment and 1/16 in. offset depending on size.

The standard couplings are made in 22 bore sizes from 3/4 in. to 6 1/2 in. diam with capacities from 4 to 550 hp. Other designs of Cone-Drive couplings including mill motor, spacer, vertical shaft, and floating shaft types can also be had in a variety of bore sizes from 3/8 in. to 6 3/8 in. diam.

Larger sizes and special types of Cone-Drive couplings will be furnished by the company on request.

For Consulting Engineers

Turn to Page 150

Keep Informed

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Spray Nozzles

An interesting new group of FullJet spray nozzles has been developed by the Spraying Systems Co., to meet the requirements of a variety of heavy-duty industrial applications. These nozzles are huge when compared with standard nozzles and provide tremendous capacities. The largest of these nozzles for example, has an orifice diameter of 5 $^{9}/_{16}$ in., is 21 in. high, and provides passage without clogging for "impurities" as large as $2^{3}/_{8}$ in. diam. Capacity of this nozzle is 1550 gpm at 10 psi.

FullJet nozzles of this type are supplied with flange mounting or with female pipe connection, in a range of over 30 sizes. This new line of FullJet nozzles is offered as an extension of the standard but smaller FullJet nozzle group. For complete information write to Spraying Systems Co., 3265 Randolph St., Bellwood, Ill., for Data Sheets 3136-F and 3136-S.

Vertical Turbine Pump Film

A new sound stripfilm (slides on continuous 35 mm strip), entitled "The Vertical Turbine Pump Story" has been released by Worthington Corp., Succasunna, N.J.

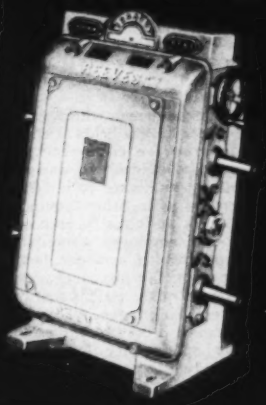
The film containing 165 frames, in color, is sychronized to a 20-min narration. It points out the four inherent characteristics of vertical turbine pumps which make them particularly suitable to applications other than the already popular use in deep wells.

The individual pictures in the color film consisting of drawings, art work, and photographs, visually clarify and emphasize the main points of the program which was designed and produced by Worthington. The purpose of the film, is to acquaint engineering and industrial circles with the advantages of using vertical turbine pumps in certain applications to which they are ideally suited—but because of habit or lack of full acquaintance with vertical turbine pumps, other types of pumps have been selected, resulting in loss of economy, loss of floor space, or loss of simplicity in the installation.

The film also shows a portion of the manufacturer's research and production operations related to the fabrication of vertical turbine pumps.

Showings will be arranged through Worthington Vertical Turbine Pump Distributors or upon contact with Worthington district office managers.

Your machines will do
More Work
Better Work
At Lower Cost
when equipped with—



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MACHINES equipped with REEVES Variable Speed Transmission handle a wider range of shapes, sizes and materials . . . do more work and better work at lower cost. Gives any machine complete stepless speed adjustability . . . provides the correct speed for each operation and each operator under every changing condition, merely by turning a handwheel, touching a button—or automatically—without stopping the machine.

REEVES Variable Speed Transmission is available in a wide choice of designs for application as original equipment or to machines in service. Capacities up to 87 hp; speed ratios as high as 16 to 1. Write for information to Dept. 4ME.

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Air-Cycle Refrigeration Units • Hydraulic Pumps
Auxiliary Drives and Controls for Guided Missiles

FOR many, many years Hamilton Standard propellers have been the most widely used item of aircraft equipment in the world. But with the advent of jet and turboprop engines, propellers are only one of many fields in which we use our modern facilities for research, design, development and manufacture.

Already we are setting the lead in the jet aircraft equipment field. This field presents a variety of fascinating challenges for the engineering mind.

To meet the new, and largest, research and development program in our 32 year history, we have just completed a 10 million dollar permanent plant in Windsor Locks, Connecticut—in the heart of beautiful New England.

Our new location offers excellent living and working conditions. It is near enough to major Eastern cities, sea and mountain resorts, to give you every cultural and recreational advantage. Yet it is rural enough to offer country-side comfort where you can work in peace and contentment.

We want men who would like to pioneer in new fields of endeavor—do *creative* engineering—enjoy freedom of decision and responsibility—and want to build a sound career with other young-minded men in an industry with a future.

Our employee benefits include group health, accident, hospitalization and life insurance, retirement income plan, paid vacations, and liberal sick leave policy. Our progressive program will provide ample opportunity for your future growth. *Actually, our technical engineering staff has continuously grown since the beginning of the Hamilton Standard organization.*

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Design, development and test engineers with initiative and resourcefulness will find full opportunity at Hamilton Standard because of the newness of the jet equipment field itself. The company's extensive facilities—its staff of youthful, yet extremely high calibre men—its policy of recognizing talent and idea—its practice of quickly assigning responsibility—and its continuous habit of promoting from within—may well be the conditions you have in mind for a satisfying lifetime career.

Simply send your resumé to the Engineering Representative, Personnel Department, at the address listed below. It will be held in strictest confidence.

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DIVISION OF UNITED AIRCRAFT CORPORATION

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Slip Roll

A new, hand-operated slip roll which forms complete circles in 16 gage steel in 1/3 less the time it ordinarily takes and also forms bends at any point in a sheet of material has been announced by O'Neil-Irwin Mfg. Co., Lake City, Minn.

Designated Di-Acro roller, an exclusive feature of the machine is a cam-actuated idler roll. Because of it, complete circles of 1-in-diam or larger can be formed in two passes through the rolls—something that usually takes several passes.

In "two-pass circle forming," the cam-operating lever lowers the idler roll to allow insertion of the material. It also raises the roll to a preset position which determines the diameter of the circle to be formed. On the first pass through the roller a half circle is formed, and on the second pass the circle is completed. In addition, it was pointed out, parts can be duplicated with great accuracy and at a high rate of production since the idler roll always returns to its preset position.

Circles of 1-in-diam only can be formed in just one pass through the roller by making slightly different adjustments.

Bends can also be located in any position along a sheet of material being formed in the Di-Acro roller because the material can be fed through the rolls without bending until the cam lever is engaged. As a result a wide variety of shapes—with straight sections on both sides of the bend—can be produced.

Round, flat, and square stock as well as many other ductile materials can be formed with this machine. Maximum material forming capacity of the roller is 1/4-in-round steel bar and 1/4-in. tubing—or their equivalents. Special rolls will be supplied, the manufacturer says, for special bending jobs.

Di-Acro roller is available in two sizes. The No. 1 roller forms material up to 6 in. in width. The No. 2 roller forms material up to 12 in. in width. Both machines will form material to a 1-in-diam or larger.

Sample material with specifications may be submitted for test forming or sample duplication, the company says. Complete information will be furnished upon request.

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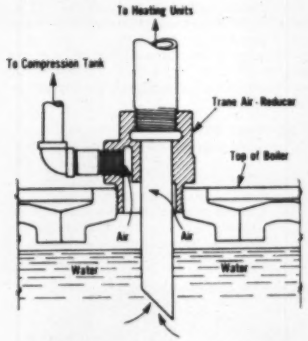
Air-Reducer

A new hot-water heating specialty—an easily installed fitting for removing air at the boiler—has been introduced by The Trane Co., La Crosse, Wis., manufacturers of air conditioning, heating, and ventilating equipment.

Design of the Trane air-reducer eliminates two adapter connections, thus enabling easier, faster, and more economical boiler installation according to the manufacturer. The air-reducer is, in effect, a pipe within a pipe. The brass inner tube extends the hot-water system's supply main below the



surface of the water in the boiler, preventing air from entering piping and heating units. Air collecting at the top of the boiler is bled off to the compression tank through the outer casting.

Further installation economies are gained through incorporating the boiler reducing bushing into the fitting, and through eliminating a nipple by fitting the air-reducer directly to the boiler. The air-reducer is made for boiler and main sizes ranging from $1 \times 1^1/_2$ in. to 3×4 in. in standard increments.

Additional information describing the new air-reducer and the other Trane hot-water heating specialties is contained in a new edition of Trane Bulletin J-355, available to the trade upon direct application to The Trane Co., La Crosse, Wis.

Aluminum Automotive Radiators

The Aluminum Company of America, Pittsburgh, Pa., has developed a new product called No XA30 Brazing Sheet which results in better construction for aluminum automotive radiators. The new product also offers excellent protection against the corrosive action of water which may be used in radiators in certain areas of the country.

Because copper, the present radiator metal, is in short supply and probably will continue to be in short supply, attention has been focused on No. XA30 Brazing Sheet as a means by which aluminum may permanently replace copper in automotive radiators. The replacement idea is not new and has been considered in terms of long-range economics by Alcoa for some time.

Several years ago Alcoa undertook development work on aluminum radiators, and this work apparently is beginning to pay off. Today, for example, 20 to 25 lb of copper are used in a standard passenger automobile radiator. Since more than 5 million automobile radiators are produced in an average year, a permanent replacement of copper

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positive protection against wear, stripping and corrosion in all tapped threads. It permits cleaner, more functional product design... it may save you many a sleepless night. Why not look into it?
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This handsome three-in-one Taylor Remo-Set thermometer makes you the weather expert in your neighborhood. The window dial indicates the present temperature as well as the highest and lowest temperature since last resetting. It is easy to read, highly accurate and attractively styled in weatherproof beige plastic case, with large ivory numerals and graduations on green dial. The reliability of this Taylor instrument is largely dependent upon the actuating element of Chace Thermostatic Bimetal.

A precision wound coil is anchored to a center stud, the present temperature pointer being attached to the outer end. Rising and falling temperatures cause the pointer to move the high and low indicators to the temperature extremes where they are locked in position, under hair-spring tension, by a ratchet mechanism. The maximum temperature indicators are pneumatically reset to the present temperature by a yoke, operated by a rubber diaphragm, and connected by a vinylite plastic tubing to a push button indoors.

Chace Thermostatic Bimetal is manufactured in 29 types, in strips, coils, random long lengths and welded or brazed sub-assemblies. We also provide specialized tooling necessary to fabricate bimetal elements to customer designs. Before proceeding with your next design, we invite you to consult our Application Engineers, recognized authorities on temperature responsive devices—or write today for a copy of our new 32-page booklet, "Successful Applications of Chace Thermostatic Bimetal," containing engineering data.

W. M. CHACE CO.
Thermostatic Bimetal
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with aluminum would result in an appreciable savings in hard-to-get copper.

No. XA30 Brazing Sheet comes into the picture in two ways. After the aluminum radiator is assembled it is placed in a brazing furnace of molten flux. One side of the brazing sheet melts at a lower temperature than the coremetal and results in a good flow of the alloy into the joints for tighter construction. When the radiator goes into service, the inside of the brazing sheet, which has a special alclad coating, gives superior protection against corrosion by water or antifreeze mixtures. Any corrosion taking place goes only as far as the core metal and then spreads out along the cladding. This action arrests further penetration of the metal for an extended period of time.

Although aluminum radiators are not yet a production reality, several manufacturers are now testing experimental models on the road.

Conveyer Belt

A rubber conveyer belt system that looks like a Coney Island roller coaster but stretches more than 2½ miles over, around, and under rugged mountains is helping to make the mountain-ringed Kanawha River Valley, near Charleston, W. Va., one of the nation's fastest-growing strategic industrial areas.

The conveyer, featuring a B. F. Goodrich rubber beltroad, transports coal from a mining area which is one of the sources of coal for a large steam-generating plant now under construction on the banks of the Kanawha at Glasgow, W. Va. Based on estimated coal deposits tapped by the belt, it is believed that the conveyer system will still be playing a vital role in the economy of this booming industrial valley a hundred years from now.

The first flight of rubber belt, a 1200-ft section, picks up coal from a drift mine 500 ft up on the side of a 1900-ft mountain and carries it down the mountainside at a 17-deg angle for an over-all drop of 296 ft.

The belt threads its way across country for more than 4000 ft, then rises to cling to the steep side of a second mountain which it circles for 4700 ft in a series of roller coaster dips and rises. The rubber beltroad next burrows into a 4000-ft tunnel drilled through the base of a third mountain. The belt emerges finally at the Kanawha River, near Montgomery, W. Va., 14,000 ft from the start of its skyscraper ride. The beltroad discharges its coal cargo into river barges.

Enroute to the river, the conveyer makes two abrupt 90-deg changes in direction, crosses over one road, tunnels under another. The entire system is composed of nine flights, or sections, of rubber conveyer belting, ranging in length from 230 ft to 3770 ft, pulley-to-pulley distance. Transfer points located where one belt ends and another begins automatically cause the coal to discharge from one belt to another.

Keep Informed — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Vertical Hollowshaft Motors

Recently added to the line of U. S. vertical motors are a series of single-phase hollow-shaft motors, types SCU-C and SCU-R. An improved and simpler method of disconnecting the starting capacitors has been initiated into this line of motors—namely, the accelerating type relay. Formerly a centrifugal switch, with its many moving parts and critical adjustment, was used. The U. S. single-phase vertical motor is designed to provide maximum performance with positive relay operation over the widest variation in line voltage.

The relay now used in U. S. motors gives a fast, clean contact break. The large double break contacts insure long and trouble-free life. The U. S. relay is similar to those used successfully for years in hermetically sealed refrigerator units. To avoid any possibility

of bearing grease working into the relay or foreign particles being blown into the contact points by the efficient ventilating system, the relay was designed into the easily inspected, split-type outlet box located on the side of the motor.

Available from $1^1/_2$ to 5-hp with speeds of 1800 or 3600 rpm, the SCU-C and SCU-R motors offer such features as asbestos protection of windings, Lubriflush lubrication, normalized castings, solid centricast rotor, downdraft ventilation, adjustable hollow-shaft, reverse protection clutch, conservatively rated capacitors and weatherproof housing. For an 8-page bulletin describing these motors, write to U. S. Electrical Motors Inc., 200 E. Slauson Ave., Los Angeles 54, Calif.

Magic-Grip Bushing

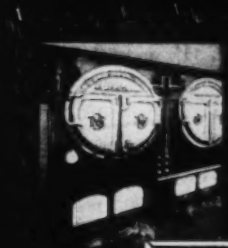
A new type of "Magic-Grip" bushing has been announced by Allis-Chalmers Mfg Co. of Milwaukee, Wis., for its stationary control, wide-range "Vari-Pitch" sheave. The new bushing makes possible quick and easy installation or removal of the sheave and permits mounting it on the shaft so that the adjusting control mechanism is either toward the motor bearing or away from it.

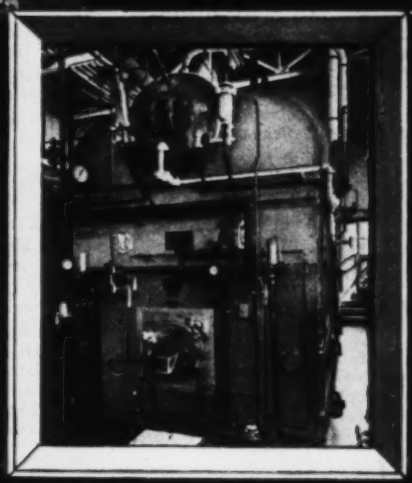
The new-type Magic-Grip bushing as used in the Vari-Pitch sheave consists of two split-tapered sheaves, one within the other. When drawn together with the locking screw, the bushing sleeve is contracted on the shaft and the outer sheave sleeve is expanded against the disks simultaneously to effectively lock the entire mechanism with all working clearances eliminated.

All torque is transmitted by keys in the two sleeves so that stresses due to starting, stopping, or sudden overloads will not affect the sheave setting in any way. Spacing of the disks to produce different pitch diam-

Type B- BIGELOW

FIT INTO THE MODERNIZED STEAM PICTURE





Twin Bigelow "B's" Give The Bristol Company Modern Steam Production and Increased Capacity In Same Space As Two 39-Year Old Horizontal Return Tubular Boilers.

TYPE B FEATURES

In many cases, sizes up to 25,000 lbs. per hr. shipped completely assembled. Minimizes field work.

Water tubes along furnace side walls reduce maintenance.

High efficiency with any firing method.

Low head room. Maximum capacity for floor area.

Will take high overloads without disturbing water level.

Write for free catalog on Type B or on any of the units listed below.

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THERE is no question about *performance* when you use Barco Swivel Joints designed for 3,000 psi hydraulic operating pressures. Barco's *exclusive* design gives you these important advantages:

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- **SELF-ALIGNING!** Speeds up and simplifies installation. Guards against wear.
- **LEAKPROOF!** Precision machined and ground ball seats perfectly at any angle on flexible seal.
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- **ABSORBS VIBRATION!** No metal-to-metal contact through joint. Moves in any direction.
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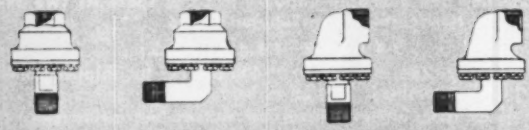
Designed to meet the most critical aircraft and ordnance requirements, Barco High Pressure Hydraulic Swivel Joints are available in a complete range of standard and specially designed styles and sizes for INDUSTRIAL APPLICATIONS. *Barco Engineers are at your service; ask for information.*

STANDARD STYLES—Steel or Aluminum Casing with Stainless Steel Ball



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Send for Bulletin 269

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The Only Truly Complete Line of Flexible, Swivel, and Revolving Joints

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eters is accomplished with the adjusting screw while the locking screw is in loosened position.

Design of the new Magic-Grip bushing which permits the sheave to be installed on the motor shaft with the adjusting screws either away from or toward the motor bearing is an exclusive feature. There is a decided advantage in being able to control the sheave from the motor bearing side, particularly on textile machinery and other machines where low hanging frames or close quarters make it difficult to use the conventional type sheave which must be adjusted at the outer end. The controlling mechanism can now be located where it will be the most convenient and easiest to get at on any drive.

The new Vari-Pitch sheave is approximately 20% lighter than the former wide-range, stationary control, straight-bore Vari-Pitch sheave. This means less weight on motor bearings and makes the sheave easier to handle.

Open-Hearth Precipitators

Nine open-hearth steelmaking furnaces now being built at U. S. Steel's Fairless plant at Morrisville, Pa. by Koppers Co., Inc., will be equipped so that smoke usually rolling from the stacks of these furnaces will be largely eliminated.

Elimination will be accomplished by Koppers-Elex Electrostatic Precipitators, a pair of which will be installed at each furnace. Electrostatic precipitators treat the furnace smoke electrically, causing the dust in it to be removed to collecting hoppers for disposal.

Koppers precipitators are being installed as integrated parts of the open-hearth structure, and are located immediately beside, and in a line parallel to the furnaces, in the system or flues between the furnaces and their stacks or chimneys. Each pair of electrostatic precipitators will be about 48 ft long × 38 ft wide × 38 ft high. The twin arrangement makes possible the by-passing of one of a pair for maintenence purposes.

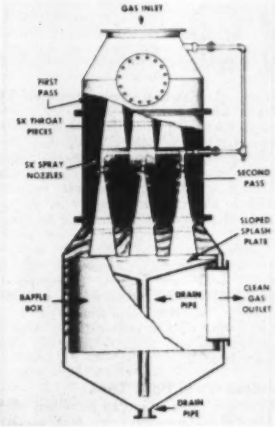
Electric energy necessary to operate the precipitators will be provided by 27 Koppers-designed packaged power units, three for each of the nine pairs of precipitators. These packaged power units energize the precipitators with direct current at about 65,000 volts.

Fairless Plant's open-hearth precipitator installation will be the second of its kind in the country, the first having been made about two years ago on the West Coast. Fairless is unique, however, as the first installation in the East and the largest anywhere. The precipitators are designed to remove more than 95% of the dust normally in the open-hearth exhausts.

"Packaged" Gas Scrubber

High scrubbing efficiency and low maintenance are outstanding features of the "packaged" gas scrubber unit, one of the types of gas and fume scrubbing equipment manufactured by Schutte and Koerting Co., Cornwells Heights, Pa.

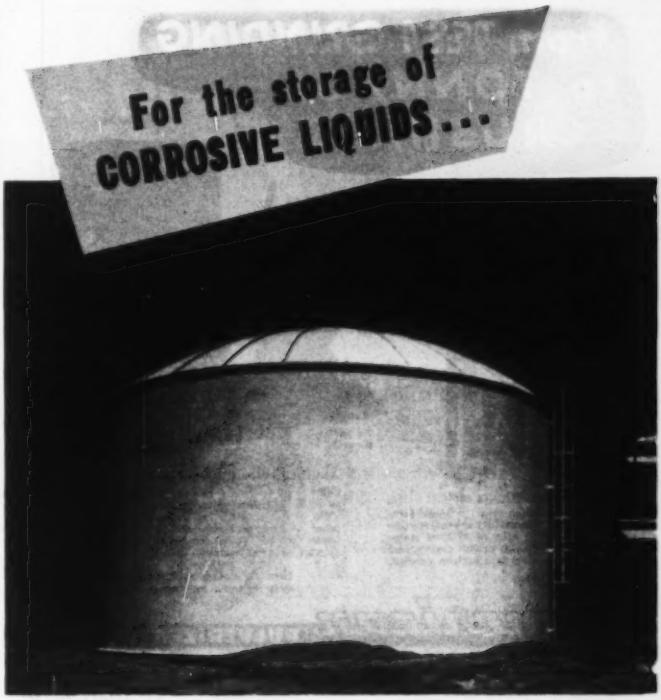
The SK Packaged gas scrubber will handle gas containing wettable solids and condensable gases as well as gases and solids which can be cleaned by obtaining a chemical reaction between the gas or solids and selected spray liquid. In the case of gases containing nonwettable solids or dust—carbon black or metal oxides for example—a suitable wetting agent can be introduced into the spray liquid.



Component parts of this unit are the scrubber box, spray nozzles, and throat pieces. The scrubber box, enclosing all components, is divided into compartments or "banks." Units can be constructed with as many banks as necessary; however, two are sufficient for most operations. The number of banks, nozzles, and throat pieces per bank are determined by the volume and characteristics of the gas and the scrubbing efficiency desired.

In operation, the gas enters the scrubber through an inlet pipe. The suction action of the spray from the nozzles draws the gas into the throat pieces of the first bank in the scrubber, where the liquid and gas are thoroughly mixed.

The mixed gas and liquid is discharged into another bank of spray nozzles and throat pieces. As the gas enters each bank it is entrained and forced through the throat pieces. When the gas leaves the last bank of nozzles and throat pieces, it is washed, cooled, and discharged through an outlet pipe.



HORTON *Stainless-Clad Steel* TANKS

Facilities for storing corrosive liquids can be completely efficient only when they are built of the proper metals. That's why the Chemical Division of the Lion Oil Company stores ammonium nitrate solution in Horton *stainless-clad steel* tanks at its chemical plant in El Dorado, Arkansas.

All shell and bottom plates in this 15,000-bbl. tank have a 1/16 in. stainless steel cladding to prevent metallic contamination of the ammonium nitrate solution during the storage period. Also, cladding results in longer, more serviceable tank life.

This tank is typical of the many tanks and processing units we build for the chemical industry. For more specific information about these structures, write our nearest office. There is no obligation on your part.

We have complete facilities for fabricating and erecting structures from . . .

- *CLAD STEELS*—chrome nickel or straight chrome stainless steel, monel or nickel.
- *SOLID METALS*—chrome nickel or straight chrome stainless steel, monel, aluminum or nickel.
- *LININGS*—chrome nickel or straight chrome stainless steel, monel or nickel.

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Seattle 1.....1321 Henry Building
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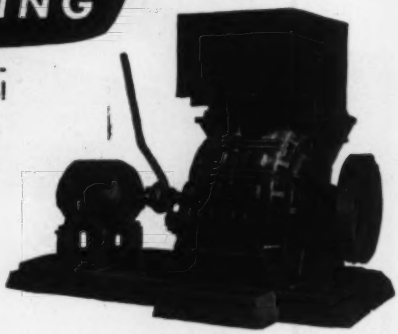
AMERICAN Laboratory Size Mills

With the same reduction action as Metal Turnings Crushers (or hammer action)—American Laboratory Size Mills offer an efficient means for reducing razor blades, pewter castings and fragile, thin brittle steel to a reclaim product.



AMERICAN Metal Turnings Crushers

Bulky, hard-to-handle turnings are rapidly reduced as much as 80% with this efficient, economical crusher. And the yield of cutting oil is increased 30 to 50 gallons per ton—proof of how profitable the installation of an American Metal Turnings Crusher can be for those who handle 20 tons or more of metal turnings a month.

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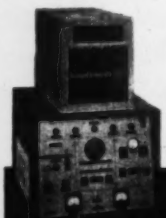

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Fast transients and high-frequency phenomena can be accurately recorded.

Several types of continuous-drive record magazines are available for 6-inch sensitized paper and film, and for 35-mm film. Drum-type magazines, both small and large, are valuable for short high-speed records. 10-foot drum-type charts can be driven at 3000 RPM for a *chart speed of 6000 inches per second* when high resolution is needed.

Useful for strain recording to 100 Kilocycles.

Automatic Operation Initiate a transient with the oscillograph, or let the transient start the oscillograph.
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Advantages of SK Packaged gas scrubber unit include: (1) it is so designed that foam surge will not choke the unit; (2) it provides maximum contact between the spray liquid and the gas; (3) it has an integral separating unit for separating the spray liquid after scrubbing; (4) it can be arranged for vertical down-flow or for horizontal operation: (5) it operates with a minimum loss of pressure; (6) it attains high scrubbing efficiency; and (7) little maintenance is required.

For further information, contact Schutte and Koerting Co., Dept. J-I, Cornwells Heights, Bucks County, Pa.

Rotary Pressure Joint

A rotary pressure joint has been announced by Seamlex Co., Inc., 4123 24 St., Long Island City, N. Y.

The accompanying illustration shows the new rotary joint designed to convey liquids and gases from a stationary pipe line to a revolving receptacle. Its outstanding features are: (1) External screw adjustment by means of which normal wear of rotary seal can be compensated for on the spot, in service, without removal of rotary joint, thus preventing leakage and greatly reducing maintenance costs; (2) floating rotary seal, made of special graphite composition, is self-aligning in any direction, axially as well as radially, thus eliminating leakage so often caused by misalignment of rotary shaft; (3) pressure-equalizing chamber relieves rotary seal of excessive pressure, reduces friction, wear and power consumption. Standard Class 15 capacity: 150 psi, 350 rpm, 350 F; standard sizes from $\frac{1}{2}$ to 1-$\frac{1}{4}$ in. psi; larger sizes in preparation. Available in syphon and single-flow types. Ask for bulletin 5500.

Stainless-Steel Pass Tank

Darkroom congestion can be ended with the new GE stainless-steel pass-tank, according to the General Electric Co. X-ray Dept., Milwaukee, Wis.

Thanks to this pass tank, users of X-ray film can place in an adjoining room the various supplies, films, and equipment that often jam the already crowded darkroom. This makes possible the viewing of wet films, loading and unloading of driers, unloading of hangers, and cutting of film corners in a room outside the darkroom.

Removal of these operations into an adjoining room prevents conflict between operations which require light and darkness, and speeds up both types of work.

The tank may be installed through the wall as a water pass—one half in the darkroom, the other in the adjoining light room. Into the latter may be placed the drier, wet-film viewer, corner cutter, and negative preservers. The tank is light proof, the space between the covers being lightproofed with a replaceable rubber strip. It is easily disassembled when cleaning is indicated. The tank is available in a 30-in. and 48-in. inside length size, and in left to right or right to left processing.

Keep Informed

NEW EQUIPMENT
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Fingerprint Remover

A new compound, Gulf No-Rust FPR, (Fingerprint Remover), has been developed by the Gulf Oil Corp., Pittsburgh, Pa., and is now being marketed throughout the Gulf sales territories.

A need for such a product is evidenced by the experience of manufacturers of parts and products with dimensional tolerances and surface smoothness of a few ten thousandths of an inch, and in many cases to a few microinches, finding the product becoming useless or inoperative due to very slight corrosion or even heavy staining. Body acids and perspiration present on the tip of the fingers are easily transferred to the workpiece through handling, gaging, working, etc. The resulting stains or corrosion can cause the product to exceed allowable tolerance and to be unacceptable.

Gulf scientists and technicians started research on this problem immediately after World War II, after wartime experiences with close tolerance machining had clearly shown staining and corrosion could result from fingerprints on the work.

After several years of testing and experimentation, Gulf No-Rust FPR was developed, and it is capable of removing damaging fingerprints and other similar corrosive materials from fine finished surfaces, and establishing a corrosion preventive film sufficient to protect the part between manufacturing operations and during temporary storage.

Gulf No-Rust FPR contains a highly effective and potent rust preventive. It may be applied to steel, brass, copper, cadmium, magnesium, zinc, and other metal surfaces by dipping, flooding, or spraying.

Gulf No-Rust FPR is recommended for application to freshly machined metal surfaces of fine finish and close tolerances such as those on antifriction bearings, instruments, and precision products, and to preserve dimension, surface condition, and appearance. This thin film fingerprint remover will displace water films by preferential wetting of the metal surfaces. Precision parts or surfaces wet with cutting or grinding compounds are cleaned and protected by immersion in Gulf No-Rust FPR. Perspiration residues are removed by dissolution; further contamination is prevented by establishing a rust and corrosion protective film, giving temporary protection to the metal surfaces.

Gulf No-Rust FPR can be readily removed with any petroleum solvent when the part is ready for use.

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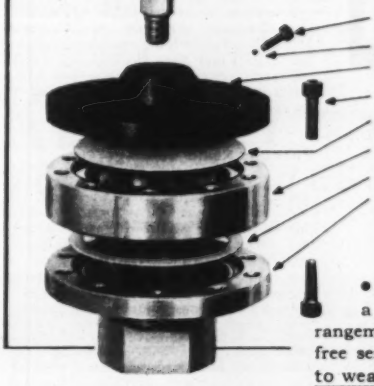
• For chemicals and liquids which would corrode or clog the Bourdon tube. Simple, sturdy construction proved in the field.

Pressures to 3000 p.s.i., vacuum, or compound; temperatures to 400° F. Diaphragm unit may be ordered separately.

FEATURES



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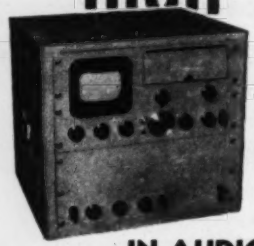

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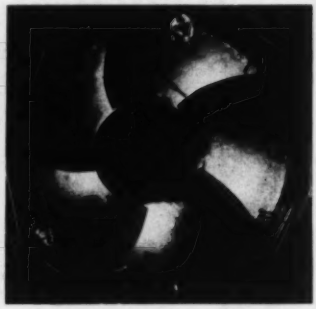
Giant Water Wheel Runner

This huge Kaplan propeller-type water wheel runner, largest of its kind in America, could be either when viewed from different angles.



Shown in process of assembly in the Allis-Chalmers shops, the runner is nearly 24½ ft in diam and weighs over 200,000 lb. The blades, with the hub, are cast separately of steel.

This runner is for one of two more 55,000-hp, 48-ft-head, 81.8-rpm Allis-Chalmers hydraulic turbines being completed for the Tennessee Valley Authority Pickwick Landing plant. Installation of these two additional units will bring the total number to six at this water power project.

Phenolic Resin Coatings

The Ric-wiL Plastic Coating & Mfg. Corp., 1290 Euclid Ave., Cleveland 15, Ohio, will enter the field of "protective coatings for industry" with their line of "Ricwilite" phenolic resin coatings. Manufacturing plant is located in Salem, Ind.

Ricwilite coatings are specially formulated to protect equipment against extremely corrosive conditions in all types of industry with a tough, impervious film which is resistant to attack by corrosive acids and alkalis, salt water, rust, and weathering. The coatings are ideal for protection of ventilating and duct systems, drill pipe, piping and equipment in food and chemical process plants, oil refineries, pulp and paper plants, sewage lines, tank cars, storage tanks, etc.

At the present time, two distinct types of Ricwilite coatings are available:

Ricwilite 1060 phenolic resin coating is of the baking or heat-hardening type. When baked at 350 to 400 F, the coating hardens or polymerizes to form a chemically inert, insoluble, corrosion-resistant coating—hard and tough, glasslike in appearance, yet flexible and elastic. Ric-wiL has a large modern plant at Salem, Ind., with complete facilities for baking, metal preparation, and application of Ricwilite coatings to all types of equipment.

Ricwilite 7100 phenolic resin coating is the cold-setting type which is cured or polymerized at room temperatures (60–80 F) by the addition of a catalyst just prior to application. It can be applied to almost all metals, concrete, wood, and plaster surfaces by brush or spray.

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Patented Flexible Disc Rings of special steel transmit the power and provide for misalignment and end float.

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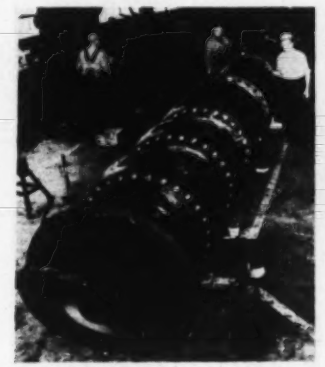
World's Largest Well Pumps

The largest deep-well turbine pumps ever built have been produced at the Pomona, Calif., pump works of Fairbanks, Morse & Co. for use by the Air Force in its rocket research program. Four of the giant pumps, designed specially for this application by Air Force and F-M engineers, are being installed at the rocket research base at Tullahoma, Tenn.

Each of the 48-in. turbine pumps is 42 ft long, weighs 30,000 lb, and can pump 25,000 gpm of water. It takes a 2000-hp motor to drive each pump and these motors were specially designed and built at the F-M plant in Beloit, Wis. The entire project, from drawing board to installation of the huge pumps, took less than a year.



In this photograph, one of the mammoth pumps is contrasted with an ordinary 6-in. turbine pump in the foreground at right.

The function of the big pumps in the Air Force's rocket research program is classified information and has not been revealed.

Ring Joint Gasket

Petroleum Mechanical Development Co., Houston, Texas, has announced the development of a new "Flex-Tip" Ring Joint Gasket. The unit will be manufactured in all sizes used in well control for pressures of 2000 psi and above.

The design of the new ring embodies two independently acting seals as compared to the one type offered by the conventional gasket. The first sealing mechanism is the standard API metal-to-metal seal acting exactly as in the standard gasket. Two additional features are the resilient Flex-Tip and the inner and outer beads which offer substantial protection against mechanical damage to the smooth steel seating surfaces. The beads also protect the ring against corrosion, since the resilient material is little affected by oil, gas, or commonly encountered chemicals.

The Flex-Tip mechanism uses the interference principle of sealing in a manner similar to that of the common "O" ring. A new compound not previously available has been employed to give heretofore unobtainable resistance to chemical reagents commonly found in connection with drilling for or producing petroleum.

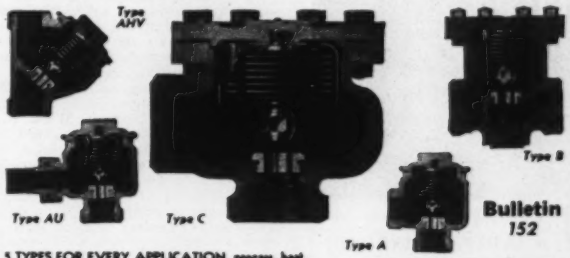
The gaskets are manufactured for 600 and 900 series in sizes 2 to 12 in.; for series 1500 in 2 to 12 in., and for series 2900 in sizes 2 to 10 in.

In This Plant Nicholson Traps

SAVE 10% IN STEAM COSTS

Chief Engineer H.F.D. stated, after Nicholson replaced mechanical traps in his plant: "Saving in steam waste cut our fuel cost at least 10%. Yet application temperatures were up 30°–40°. And relief of all air binding effected faster warm-up."

Operate on lowest temperature differential, 2 to 6 times average drainage capacity; maximum air venting. For other advanced Nicholson features send for Bulletin 152.



Bulletin 152

5 TYPES FOR EVERY APPLICATION, process, heat, power. Sizes ¼" to 2"; pressures to 250 lbs.

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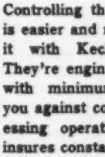
for dependable, accurate liquid level control!

- No. 15 Balanced inner valve double seat. Pressures to 125 lbs.
- Specify No. 14 single seat float valve where tight closing is required.
- Bronze bodies, integral seats ½" to 1½" inclusive. Semi-Steel bodies, bronze trim, renewable seats, 2" to 12" inclusive. Globe or angle patterns.
- Seamless copper floats standard. Stainless Steel floats available.
- Closed tank controls also available.

Controlling the liquid supply to open tanks is easier and more dependable when you do it with Keckley balanced float valves. They're engineered to give you long service with minimum maintenance—and protect you against costly failures that disrupt processing operations. The balanced feature insures constant even flow and positive closing action regardless of the incoming pressure. Keckley float valves are available in sizes from ½" to 12". Screwed, standard or extra heavy flanged connections.



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Welding Analyzer

A new direct-writing welding analyzer now records single-phase and three-phase resistance welding machine variables. Welding current and electrode force are measured and recorded simultaneously, and show the important squeeze, weld, hold, and off time intervals. The new analyzer also records the small 180 cps component present in the three-phase welding machine current when ignitron rectifiers are used. The welding engineer can adjust the welding machine as the measurements are being made, due to the immediate availability of the information on the direct-writing oscillograph.

This new welding analyzer, The Brush Development Company's Model BL-213, consists of their modified Model BL-202 dual-channel oscillograph, a modified Model BL-932 DC amplifier, and the Brush Model BL-320 universal amplifier. The modifications in particular enable the analyzer to record at the frequency of 180 cps for three-phase timing purposes. The operating variables of resistance spot, projection, and seam-welding machines can also be accurately recorded.

A detailed description of the Welding Analyzer may be obtained from The Brush Development Co., Instrument Div., 34E, 3405 Perkins Ave., Cleveland 14, Ohio.

Business Notes

Republic Announces Branch Office Relocations

Republic Flow Meters Co. of Chicago, Ill. opened a Houston, Texas, factory branch office to serve the rapidly expanding industries of the Texas Gulf Coast. The new company office will be located at 2426 W. Holcombe Blvd., Houston.

Other recent additions to Republic's field engineering staff include: A new factory branch office at 1002 Second Ave., Seattle 4, Wash.; St. Louis district office was moved to larger quarters at 13 So. Meramec St., Clayton 5, Mo.; Philadelphia district office has been expanded and relocated at 308 Suburban Square Bldg. in Ardmore, Pa.; and the Syracuse, N. Y., branch office was recently located at 317 State Tower Bldg.

Cleaver-Brooks Names Manufacturer's Representatives

The Cleaver-Brooks Co. of Milwaukee, Wis., announces the appointment of the V. N. Harwood Co., Buffalo, N. Y., as a manufacturer's representative for the sale of Cleaver-Brooks boiler equipment.

The firm, managed by Van Ness Harwood, is located at 250 Delaware Ave., Buffalo, 2. Its territory will include eight counties in western New York, and four counties in northwestern Pennsylvania.

The Company also announced the appointment of the Wilson-Weesner-Wilkinson Co. of Nashville, Tenn., as a manufacturer's representative.

The firm is located at 310 South 2nd St., Nashville 6, Tenn., and will handle a territory that includes 37 counties in Tennessee and 26 counties in Kentucky.

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G-E Capacitor Plant Hits Full Production Stride

The General Electric Company's new capacitor plant at Hudson Falls, N. Y., in April hit full production for the first time since it was moved last autumn.

Formerly located at Pittsfield, Mass., the Capacitor Dept. now occupies in Hudson Falls 13 buildings previously owned by the Union Bag and Paper Company.

Included in the Department's new facilities are manufacturing and storage buildings, and a power plant. More than 1000 persons are presently employed in the manufacture of power factor and specialty capacitors at the newly converted plant and at an existing plant in Ft. Edward, N. Y.

Syntron Purchases Canadian Plant

Syntron Co. of Homer City, Pa., manufacturers of vibratory material handling equipment, portable power tools, Diesel pile hammers, selenium rectifiers, shaft seals, paper joggers, etc., has organized a Canadian subsidiary, Syntron Ltd., and purchased a manufacturing plant in Stoney Creek (Hamilton area) Ontario, Canada.

Syntron Co. has disclosed that selenium rectifiers will be the first item to go into production, although ultimately, the entire line will be manufactured in the Stoney Creek plant. It is expected that production will start sometime in September or October, 1952.

While Syntron Co. has for many years maintained district sales offices in Canada, it is felt that the new factory and the Canadian company will provide improved sales and services.

Wolverine Tube Establishes Technical Sales Unit

A Technical Sales Unit, designed to render technical service on problems particularly related to heat transfer and product fabrication was announced by the Wolverine Tube Div. of Calumet and Hecla Consolidated Copper Co., Detroit, Mich.

The Technical Sales Unit will headquarter in the company's General Sales Offices at the Guardian Building in Detroit.

Westinghouse Renames Central Station Department

Effective Feb. 1, 1952, the name of the Central Station Dept. of the Westinghouse Electric Corp. was changed to Electric Utility Dept. In making the announcement the company said that the change applies to all elements of the Apparatus Div. that formerly used the term Central Station.

The change was made because it was felt that the new name more accurately describes and associates the Corporation's activities with the electric utility industry.

Leslie Co. Increases Engineering Facilities

A new wing providing increased engineering space has been added to the plant of Leslie Co., Lyndhurst, N. J., manufacturers of pressure and temperature regulators and controllers, to cope with the fast growing needs of this vital industry.

This new and larger Engineering Department includes a larger modern drafting room and new test laboratory, which provides added facilities for long-range research and development to add new and improved equipment to the Leslie line of products.

This big Pangborn "CH" Collector, at Gordon City Foundry, Stoughton, Wis., serves the foundry's grinding wheels and its Pangborn Blast Cleaning Machines. Result: Plant and equipment are protected from excess abrasive dusts, and employees work in a dust-free area!

GOT a DUST PROBLEM?

Here is the hood and piping system which conveys dust laden air to Pangborn Collectors at Middlesex Silver Co., Middletown, Conn. Valuable silver fines recovered with this system are worth $15,000 a year, after all operating costs of the system have been paid!

This one Pangborn installation solved six dust control problems for Kingsbury Machine Tool Co., Keene, N.H. Heating costs have been lowered substantially through recirculation of cleaned air, costly dust damage to machinery and products has been prevented, and workers' efficiency has increased!

THE THREE EXAMPLES you see here are actual case histories of dust problems solved by Pangborn Dust Control Equipment. In each case, Pangborn engineers studied the problem, recommended a solution, and worked closely with plant supervisory personnel in securing the greatest benefits possible from the dust control equipment.

Not that these examples are unusual; they're typical of Pangborn's day-to-day operation. Improving working conditions, removing dust hazards, improving community relations, saving money through reclamation and salvage of the dust collected—these are Pangborn's stock-in-trade—these are the benefits literally thousands of plants are enjoying, thanks to Pangborn.

What are your Dust Problems? Find out what Pangborn can do to solve them. Write for Bulletin 909A. Address: PANGBORN CORP., 2200 Pangborn Blvd., Hagerstown, Md.

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Pangborn DUST CONTROL

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Detroit Stoker Appoints Cleveland Representative

The Detroit Stoker Co. of Detroit, Mich., has appointed the Stephan Co., 7016 Euclid Ave., Cleveland, Ohio, as district representatives for the Cleveland territory.

Westinghouse Announces $32 Million Expansion Program

A $32 million expansion program that will take about a year to complete is under way at the South Philadelphia Works of the Westinghouse Electric Corp.

The project involves re-occupancy, under lease agreement, of the Navy-owned Merchant Marine plant adjoining the South Philadelphia Works, extensions to existing buildings, extensive purchases of new machine tools, and a previously announced $6 million steam and gas-turbine research and development laboratory.

The current program will materially increase production of marine propulsion units of all sizes and electric utility turbines in sizes from 10,000 to 250,000 kw. It will also provide needed manufacturing facilities to increase production of gas turbines, now being used in greater numbers as prime movers for power generators, to drive locomotives, and to pump gas through the nation's pipelines.

The re-activated facilities in which Westinghouse produced steam turbines and gears for merchant ships for the United States Maritime Commission during World War II, include a main building nearly a quarter of a mile long and with more than 600,000 sq ft of manufacturing area. Included in the building are three high bay manufacturing aisles that are 80 ft wide, and three bays for machine shops that are 48 ft wide.

Large electric utility turbines will be assembled and tested on the assembly floors. One section will be devoted to fabricating condensers and manufacturing, assembling and testing coolers and heat-exchange equipment. This area will allow the Division to triple its output of heat exchange apparatus. Other parts of the building will make marine propulsion equipment and land gas turbines for electric utility and industrial purposes.

Johns-Manville To Expand Watson Plant

A major expansion of the Johns-Manville plant at Watson, Calif., for the production of industrial insulations, was announced recently.

The expanded manufacturing facilities would provide the Long Beach, Calif., area with an additional 80 to 100 new jobs and an added annual payroll of about $350,000.

It is expected that construction of the building to house the new operations will be completed in the early fall of 1953. The building will enclose about 100,000 sq ft of floor space.

The expansion is being made to better serve Johns-Manville's industrial customers in the West Coast, Rocky Mountain, and Southwest areas. The insulations to be produced at Watson are used by Western railroads, steel plants, the heat-treating and metals industry, the petroleum industry, public utilities, and other industries where heat control is necessary. The Watson plant, when completed, will also export industrial insulations to the Hawaiian Islands and Central and South America.

It is anticipated that the Watson addition will produce about $2,500,000 of industrial products annually.

For
TOP EFFICIENCY
INSULATED
PIPING
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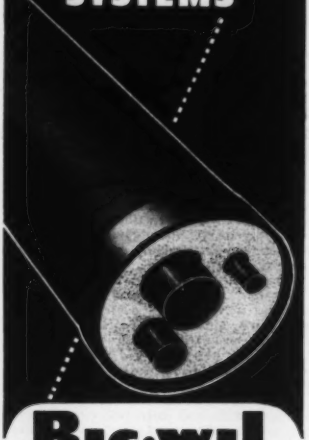

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When you have an insulated piping problem, remember that only the best will give you ALL the advantages necessary to full-efficiency performance of your system. That means Ric-wiL Prefabricated Insulated Piping.

Ric-wiL provides (1) top-efficiency system engineering, (2) fast, economical installation, (3) the right protection and insulation for the job.

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CLEVELAND, OHIO

Ric·wil PREFABRICATED INSULATED PIPING — UNDERGROUND OR OVERHEAD

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LATEST CATALOGS

Graver Water Conditioning to Expand

Graver Water Conditioning Co. of New York, manufacturers of equipment for all water-conditioning processes, announces the further expansion of its technical organization to extend its services to central power generating stations, industrial plants, and municipalities. A new Research and Product Development Department has been created.

Kewanee-Ross Corp. Formed

American-Standard announces formation of Kewanee-Ross Corp. through the joining of Kewanee Boiler Corp., Kewanee, Ill., and Ross Heater & Mfg. Co., Inc., Buffalo, N. Y. This new corporation will operate as a subsidiary of American Radiator & Standard Sanitary Corp., with headquarters in Kewanee.

B&W Plan Texas Plant

The Babcock & Wilcox Co. has started construction on a new plant in Paris, Texas. This is the third new plant to be announced by the company within a year.

The plant will employ 750 men when it gets into operation this summer, and will manufacture components for large utility and industrial boilers. It will also assemble smaller FM boilers, a new integral unit recently designed by the company.

Total area under roof in the new plant will be 135,000 sq ft composed of three bays 500 × 90 ft. In addition there will be 1500 ft of uncovered craneway.

Latest Catalogs

Radiator Traps

Bulletin No. 452, issued by W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa., describes Type R radiator traps for vapor and vacuum steam-heating service. Features, construction, and prices are included.

Carbon Steel Tubing

Technical information of value to engineers and designers associated with the fabrication of equipment operating at elevated temperatures and pressures is presented in a new data card published by The Babcock & Wilcox Co., Tubular Products Div. Known as TDC 142, the bulletin offers condensed data on mechanical and physical properties, upsetting, swaging, flanging, expanding, bending, and welding of seamless and welded carbon steel tubing. Copies of the bulletin are available from the general offices of the division at Beaver Falls, Pa.

Refrigerant Purger

Armstrong Machine Works, Three Rivers, Mich., has issued a new 4-page bulletin describing its No. 370 forged steel purger for venting air and other noncondensable gases from refrigerating systems. The bulletin describes the air problem, explains how the purger operates, and gives physical data and list price. Also included are reports from users describing benefits obtained. The purger is described as being suitable for use with all common refrigerants. A satisfaction or money back guarantee is described in the bulletin.

Engineered . . .

to permit greater load-speed capacity

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Trade Mark Reg.
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The Proven Gear-Type Coupling With Fully Crowned Teeth . . . A Major Improvement in Gearing
Pat. & Pat. Pending

THIS FUNDAMENTAL IMPROVEMENT in gear tooth design practically eliminates all "end tooth and tip" contact and provides greater freedom of axial movement. This tooth design accomplishes tight fit on the crown as well as on the flanks. It is the first gear tooth on which all the load is carried on strong flanks rather than tooth edges. It reduces backlash to a minimum. These advantages, plus thrust compensation, and correction for angular and lateral misalignments give maximum relief from coupling failure grief.

Amerigear Couplings, made in several standard types, are available for standard shaft sizes and a wide range of speed and load capacities. Catalog of standard type Amerigear Couplings is available on request. Amerigear Power Transmission Engineers are available for consultation.

AMERICAN FLEXIBLE COUPLING COMPANY

Originator of the Amerigear Fully Crowned Tooth

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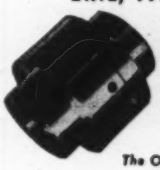

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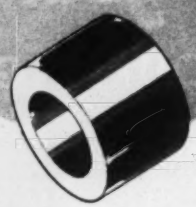

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Widely Used Where Ordinary Oil Lubrication Is Impractical or Impossible.

EXCELLENT DURABILITY • CONSTANT CO-EFFICIENT OF FRICTION • APPLICABLE OVER A WIDE TEMPERATURE RANGE — EVEN WHERE OIL SOLIDIFIES OR CARBONIZES • OPERATE DRY, OR AT HIGH SPEEDS SUBMERGED IN WATER, GASOLINE AND OTHER LIQUIDS • EXCELLENT FOR CURRENT-CARRYING BEARINGS

GRAPHALLOY materials are also in wide use for oil-free, self-lubricating piston rings, seal rings, thrust washers, friction discs, pump vanes etc.

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CONTACTS

For applications requiring low electrical noise, low and constant contact drop, high current density and minimum wear. Used for SELSYNS, DYNAMOTORS, SYNCHROS, ROTATING STRAIN GAGE pick-ups and many other applications. Brush Holders and Coin Silver Slip Rings also available.

Write for data sheets. Outline your problem and let us help solve it.

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Crown Couplings

The De Laval Steam Turbine Co., Trenton, N. J., announces availability of a new four-page bulletin, No. 2200, which describes the De Laval Crown Coupling. Complete data on this flexible coupling is included. Gives complete information on construction, horsepower ratings, speeds, applications, and selection.

Finned Tube Exchangers

The Griscom-Russell Co. has published a bulletin on a finned tube heat exchanger with a particularly wide application for heating and cooling liquids and gases, and for condensing vapors.

The bulletin fully describes this exchanger, known as the G-R Twin G-Fin Section, and explains the features of its design and construction that have proved to give highly effective service in installations totalling more than 70,000 sections. Complete construction details, specifications, dimensions, and installation arrangements of these standard interchangeable units are also included. A section of the bulletin contains many illustrations of representative installations on various types of duties, together with field reports of service records.

Copies of the bulletin No. 1400, can be obtained from The Griscom-Russell Co., Dept. CC, Massillon, Ohio.

Pressure-Type Filters

Graver Water Conditioning Co., has published a bulletin on pressure-type filters for the removal of visible suspended matter from water.

The bulletin describes the details of design and construction of these units, which are built in both vertical and horizontal types, together with all the accessory equipment which is furnished to help promote maximum efficiency. The various available arrangements of valves and piping, and aids in their selection for individual requirements, are also fully discussed. Many illustrations of installations are included, together with complete tables of capacities, dimensions, and weights for both horizontal and vertical filters.

Copies of bulletin No. WC-107 can be obtained from Graver Water Conditioning Co., Dept. 21-7, 216 West 14th St, New York 11, N. Y.

"Magic-Grip" Bushing

A new four-page leaflet giving dimensions and engineering information on wide-range stationary control "Vari-Pitch" sheaves equipped with a new type "Magic-Grip" bushing for use with "Q" or "R" section belts has been released by Allis-Chalmers. The new bushing makes possible quick and easy installation or removal of the sheave and permits mounting it on the shaft so that the adjusting control mechanism is either toward the motor bearing or away from it. In addition, the sheave with bushing is about 20 per cent lighter than the former style wide-range Vari-Pitch stationary-control sheave. Factors governing proper selection of a wide-range "Texrope" drive using the Vari-Pitch stationary control sheave are fully explained in the leaflet. Copies of it, No. 20S7811, are available from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

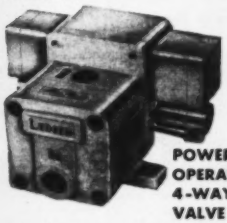
GET THE MOST OUT OF YOUR CYLINDERS with Ledeen VALVES

HAND OPERATED 4-WAY VALVE

Three models: Completely Manual—Spring Return to Neutral—Spring Return to Reverse. Flow cycles to handle most requirements.

FOOT OPERATED 4-WAY VALVE

Same as Hand Operated Valve, except foot operation replaces hand. Leaves hands free for other work.



POWER OPERATED 4-WAY VALVE

For remote control, safety or automatic equipment. Suitable for solenoid, cam, finger, toe or hand operation.

Ledeen valves are built in sizes from ⅛" to 1¼" standard pipe tap—to operate air and hydraulic cylinders and motors, single and double acting.

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VALVES • CYLINDERS
AIR-HYDRAULIC PUMPS & BOOSTERS
VALVE ACTUATORS • AIR HOISTS

Ledeen Mfg. Co.
1600 San Pedro
Los Angeles 15, Calif.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Iron Castings Glossary

A 36-page glossary of terms for producers and users of iron castings explains over 150 technical terms that are used in common between suppliers and users of ferrous and nonferrous castings. Offered to increase the mutual understanding that promotes greater accord in working out the procurement of satisfactory and improved castings, the glossary should prove useful to the designer, machinist and purchaser of castings as well as to the man in a foundry. Available from International Nickel, Dept. EZ, New York 5, N. Y.

Mechanical Development Apparatus

New 16-page illustrated brochure, MDA-200, describes the complete line of precision components for rapid and economical assembly of control systems instruments, and analog computers for breadboard and semipermanent assembly. In addition to the previously standard articles the brochure features a greatly expanded line of new mechanical development apparatus components. The new components include: lead-screw unit, clutch, bevel gears, limit stop, dials, cams, bellows and Oldham couplings, spring-loaded split gears, shaft adapters, block and switch assembly, and larger mounting boards. Available from Servomechanisms, Inc., Westbury, L. I., N. Y.

Gear Hobbing Machine

A new 12-page bulletin (1458-52) describing the new production model 1458-A Michigan ultra speed gear hobbing machine is available from Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich.

Included in the two-color bulletin are complete design and operating descriptions, tooling layouts for hydraulic clamping, and general machine specifications. A sequence of illustrations shows how the machine accurately hobs the teeth on two 3 1/2-in-diam helical gears with a 1 5/8-in. total face width in 58 sec.

Cost-saving advantages of Michigan ultra-speed hobbers are discussed. A push-button-controlled preselective adjustable hob shifter available on the machine as optional equipment is also described.

A table on the back cover lists specifications for standard "Michigan Process" unground and "Michigan" ground multiple thread hobs for use on the ultra-speed hobber.

Distribution Apparatus

A 100-page catalog, the Distribution Apparatus Digest for 1952, is available from the Westinghouse Electric Corp. Preceding the catalog section are conversion tables and formulas, approximate discounts, a Quick-Finder index, and a discussion of standardized substations for distribution systems.

The catalog presents complete data on the following distribution apparatus: Distribution transformers, Dry type transformers, Feeder-voltage regulators, Instrument transformers, Meters, Instruments, Capacitors, Lightning arresters, fuse cutouts and fuse links, Reclosers, sectionalizers, and oil switches, Oil circuit breakers, Air circuit breakers, Disconnect switches, De-ion power fuses, Porcelain insulators, Street lighting.

For a copy of catolog 50-000, contact your local Westinghouse representative.

One of four Stainless Clad Fermentors, each 12'0" dia. x 22'7" . . . Coils are of Type 304 Stainless.

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HEAT EXCHANGERS

NEW YORK OFFICE, 30 CHURCH STREET

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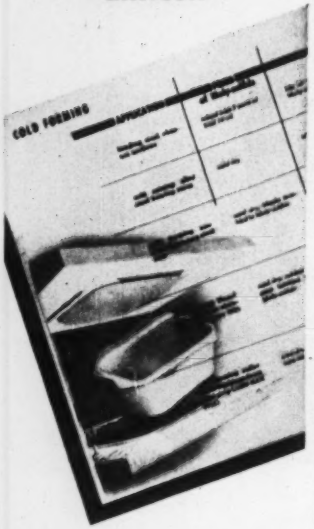
A LITTLE DOES A LOT

shows up best where the frictional conditions are difficult



The case-histories of 154 difficult friction problems in the shop and in the field, all successfully solved, are described in a new 40 page booklet.

It is where conditions are extreme that ***Moly-sulfide*** excels over other lubricants. If you encounter extreme conditions of pressure, temperature or velocity, send for this free booklet.

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Roller Chains

A new 148-page roller chain engineering data book, No. 2457, is available from Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill. Detailed engineering information covers the selection, installation, lubrication, and maintenance of roller chain for drives and conveyers and sprocket wheels.

For reference and easy identification, the book contains a large number of photographs and line drawings of the many types and sizes of chain and sprocket wheels available in the Link-Belt precision steel roller chain line. In addition, over 50 typical conveyer chain attachments are shown. The user, applying his information to the data in the book, can determine the proper roller chain for any application.

To facilitate selection of drives for normal requirements, one section of 24 pages contains a comprehensive group of preselected drives which are available for delivery from stock.

Where resistance to corrosion is required, the book offers a guide to the application of stainless steel and bronze chains. Included is a table which lists the degree of resistance of these metals to 400 corrosive re-agents.

Sections on installation, maintenance, and lubrication discuss such factors as shaft and sprocket wheel alignment, chain installation and chain tension, casing assembly, and methods of lubrication for varying conditions.

Measuring Devices

"Precision—A Measure of Progress," a new educational booklet available from General Motors, traces the development of measuring devices from the time of Noah to today.

The 63-page booklet, with 59 illustrations in color, is available in limited quantities to teachers in schools and colleges, and libraries, and other educational institutions. Requests should be addressed to General Motors Educational Relations Activity, Detroit 2, Mich.

The foreword cites the necessity for precision measurements today.

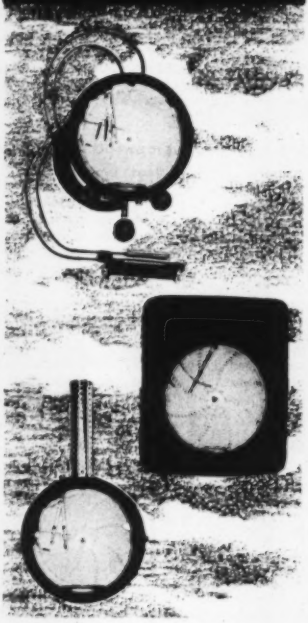
The book also points out that Noah's Ark was 300 cubits long, and that a cubit was the distance from a man's elbow to the end of his middle finger, roughly $1^1/_2$ ft, depending on the man's size. The origin of the inch, foot, yard, and other measurements are explained, as well as the basis for the metric system.

The book tells how two early scientists, Gascoigne and Palmer, developed the forerunner of the micrometer, measuring within one thousandth of an inch, and of the steel gage blocks, accurate within only a few millionths of an inch, produced by Carl Johansson. Today, however, intangible things like electrons, air flow, light waves, supersonic sound waves, and high frequency radio waves are employed as aids for the utmost in accuracy. They have brought accuracy of millionths of an inch, with the possibilities of billionths.

GIVE
and give generously

WIDEST RANGE OF EQUIPMENT FOR

HUMIDITY RECORDING



No matter what problems you face in obtaining suitable humidity measurements and records, the unique versatility of Foxboro Humidity Instrumentation offers an appropriate solution. Included are Recorders, Recorder-Controllers, Indicators, for relative humidity (hair and membrane), wet-and-dry bulb measurements, and for direct reading dewpoint or absolute humidity measurement (with the exclusive Dewcel element). Available in portable, close-coupled and long-distance types; with round or rectangular cases.

Write for full details in Bulletins 188-5 and 407. The Foxboro Company, 969 Norfolk St., Foxboro, Mass., U.S.A.

FOXBORO
HUMIDITY INSTRUMENTS

Ash and Dust Handling

A new catalog No. 652, covering "Pneumatic Ash & Dust Handling Systems," has been issued by The Allen-Sherman-Hoff Co., Wynewood, Pa.

Portable Pyrometer

A new portable Diesel engine pyrometer is described in bulletin P1247, available from the Bristol Co., Waterbury, 20, Conn. The new instrument is designed for test purposes and for installations where no permanently mounted pyrometer is available. The thermocouples can be installed in each cylinder and in the main exhaust line. Temperatures can then be checked at any time by inserting the pyrometer prongs into the corresponding receptacles in the terminal head of the thermocouple.

Investment Castings

In a new booklet, Precision Metalsmiths, Inc., describes the wide range of possible uses for investment castings and the facilities for design and production the firm offers.

Step-by-step illustrations show the process with which the firm has cast more than 160 different ferrous and nonferrous alloys for parts ranging in weight from a fraction of an ounce to more than 5 lb.

The booklet, titled, "Pour Yourself an Assembly," is available from Precision Metalsmiths, Inc., 1081 East 200th St., Cleveland 17, Ohio.

Gages and Valves

Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass., have released a new bulletin, No. 179, describing Jerguson heated and cooled gages and valves. Two models, external tube and internal tube, are covered.

Dehumidifying Equipment

A new 32-page bulletin, "Because Moisture Isn't Pink," tells how Pittsburgh Lectrodryer Corp. dehumidifying equipment solves moisture problems for industry. Illustrated by 70 photographs and diagrams of actual installations, the bulletin describes many production, handling, and storage problems that were successfully solved by installing Lectrodryers. Bulletin No. 222 is available from Pittsburgh Lectrodryer Corp., P.O. Box 1766, Pittsburgh 30, Pa.

Kennametal Tools

The field for effective use of Kennametal has been broadened through the introduction of new and improved tools presented in catalog, No. 52, including: Top-clamp Kennamatics, button-type planer tools, heavy-duty kendex inserts, railroad shop tools, "KF" and "MF" Kennamills, typical profiling tools.

All products are grouped and listed for maximum convenience in selecting, specifying, and ordering available from Kennametal Inc., Latrobe, Pa.

Syntron Equipment

A new miniature catalog No. 525 which provides pertinent data on the entire line of Syntron equipment, in condensed form, is available from Syntron Co., Homer City, Pa.

Solenoid Valves

The complete new line of "Shear-Seal" solenoid valves—shut-off, 2-Way Diverter, 3-Way Selector, and 4-Way Selector—is covered in the Barksdale Catalog 1B-2 along with illustration and description of the "Shear-Seal" principle. Valves for air, water, and oil service come in three groups of pressure ranges—0 to 250 psi, 0 to 1500 psi, and 0 to 3000 psi. Available from Barksdale Valves, 1566 E. Slauson Ave., Los Angeles 11, Calif.

Stainless Steels

A newly revised edition of a comprehensive catalog on stainless steels has been published by Armco Steel Corp., Middletown, Ohio. It describes the company's technical services; fundamentals of stainless steels; chromium nickel types, ferritic chromium, martensitic chromium, and the new precipitation-hardening types. Various properties of these steels are dealt with in detail; and there are sections on available products, as well as summaries on fabricating practices, blackening, and electropolishing.

HANKISON model B-30

Condensifilter

GIVES YOU CLEAN, DRY AIR FOR OPERATING INSTRUMENTS

The Condensifilter combines an efficient condensing unit for removing moisture . . . a mechanical filter for eliminating dirt . . . and a self-purging trap which automatically discharges the condensate. Only 15" high, the Model B-30 has a capacity of 30 cfm of free air at 100 psi.

Write for Bulletin B-30A

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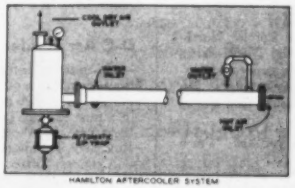
Pittsburgh 16, Pa.

If you are up in the air about what to buy
Come down to earth where the air is dry.



HAMILTON AFTERCOOLER SYSTEM

MURPHY AFTERCOOLER SYSTEM

The Hamilton Aftercooler System is of the counter current flow design, for the greatest efficiency in cooling compressed air to within a few degrees of the cooling water; the cooled air then enters the regular patented Type A Murphy Automatic Separator where moisture is ejected through the automatic Zip Trap and cool dry air is delivered to the distributing lines.

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AFTERCOOLERS • SEPARATORS • STRAINERS • TRAPS
SPRAY GUNS • PISTOL SPRAYERS

JAS. A. MURPHY & CO.

Moisture Elimination Up To 3000 Pounds Per Square Inch

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"I'm a BOEING engineer!"

FOR 35 years, Boeing engineers have pioneered outstanding designs for both civilian and military aircraft. During the last war, the B-17's and the B-29's dominated America's bomber fleets. Today the Air Force has an effective aerial team in the swift Boeing B-47 Stratojet medium and the new eight-jet B-52 Stratofortress heavy bomber shown above.

You'll be proud to work with the men who designed and produced these revolutionary, trail-blazing airplanes. You can join them on future work on these jet bombers — and on such challenging, long-range projects as nuclear-powered aircraft, guided missiles and other secret programs.

There are openings at Boeing right now for experienced and junior engineers in all fields, for aircraft

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also for servo-mechanism and electronics designers and analysts, and for physicists and mathematicians with advanced degrees.

Work and live in the Pacific Northwest in Seattle, or in the Midwest in Wichita. Boeing provides generous moving and travel allowances, offers you special training and a salary that grows with you.

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Engineering opportunities at Boeing interest me. Please send me further information.

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Screw Pumps

Bulletin No. S204, 18 pages, describes and illustrates Warren-Quimby screw-type rotary pumps. Sectional and exterior views, installation pictures, dimensions, engineering data, selection chart, etc., are included. Available from Warren Steam Pump Co., Inc., Warren, Mass.

Return Sludge and Aeration

A new Application Engineering Data Sheet, issued by The Foxboro Co., describes how modern instrumentation controls air and return sludge, the two important and troublesome variables in the operation of municipal and industrial activated sludge plants. Regardless of variations in the flow of raw sewage, the automatic control system maintains the desired ratio between influent flow and return sludge or air. The constant adjustment and maintenance, necessary with manual control, are thereby eliminated.

Control details and a complete description of the process are contained in AED 833-9, available from The Foxboro Co., 26 Neponset Ave., Foxboro, Mass.

Liquid Agitators

A new 16-page brochure on Struthers Wells Liquid Agitators and Processing Vessels has been published by the Mixing Equipment Div. of Struthers Wells Corp. Following an outline of the fundamentals of four types of liquid agitation—propeller, open impeller, shrouded turbine, and radial propeller—the bulletin presents technical details, illustrations, dimensional drawings, and size data on a variety of Struthers Wells equipment. Included are marine propeller agitators; radial propeller agitators; agitator drives; and an advanced agitator design for quick dispersion of liquids, gases, and solids.

Also in the brochure is a section on mixing equipment for solids, semisolids, pastes, and liquids; as well as a number of pages devoted to custom-made pressure vessels which are manufactured to standard design.

Copies of this bulletin may be obtained from Struthers Wells Corp., Mixing Equipment Div., Warren, Pa.

D-C Arc Welder

Up-to-date information on engineering improvements and application refinements of the Type RA d-c arc welder are offered in a new 12-page booklet No B-5453, available from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Although introduced several years ago, this selenium rectifier welder has been the subject of continuous engineering studies that have resulted in improvements such as the "arc drive control," a device that enables the operator to adjust welding transient characteristics to suit each job.

Included is information on the performance characteristics of this welder, its physical construction, electrical specifications and ratings, and approximate dimensions and weights.

To complete the current story on Type RA d-c arc welders, illustrated sections about dual units, Heliarc torch welding, duplex welders, stud welding, and control attachments (both arc-drive and remote) are covered.

ENGINEER
WITH A WEIGHTY PROBLEM

IRVING ALUMINUM GRATING

Irving Aluminum Grating is the solution where Strength and very Light Weight are wanted. Spark Proof. Rust Proof.

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Buying Glucosates

D. W. Haering & Co., Inc., have just issued a new booklet announcing a new way to buy glucosates.

They will now sell their various glucosates, which are a corrective for corrosion and scale, in drums ready to use. This will apply to all their glucosates such as Quachrom Glucosate, Sodium Chrom Glucosates, Acid Chrom Glucosate, Cupric Chrom Glucosate, Phenochrom Glucosate, Pyro Glucosate, Tetra Phospho Glucosate, Hemi Phospho Glucosate, Beta Glucoside, Sodium Glucosate, and Sulpho Glucosate.

The booklet tells the particular use each glucosate has in the correction and control of corrosion, scale, and algae.

Write to D. W. Haering & Co., Inc., Harlandale Station, San Antonio, Texas, for a copy of "A New Way to Buy Glucosates."

Test Stands

Featuring seven modifications of Aero Test-Stands and interesting ways of testing components, a new Bulletin has been produced by U. S. Electrical Motors Inc. It tells how test stands with variable speed can be profitably and scientifically used in testing magnetos, generators, alternators, hydraulic pumps, constant speed drives, actuators, etc. The test stands, ranging in rating from 1/4 to 70 hp, have output speeds up to 15,000 rpm. Dual heads are shown which enable a tester to test two components simultaneously. New design features include Orifeed, a method of measuring the amount of lubrication to the gearing. Graphs show comparisons of variable speed systems, load ratings and relative speeds. The new Varitrol system of maintaining a predetermined speed regardless of load is described. This new bulletin No. 1749 may be obtained from U. S. Electrical Motors Inc., 200 E. Slauson Ave., Los Angeles 54, Calif.

Pit Mining and Petroleum Production

Advances in underground and pit mining, quarrying, and petroleum production through mechanization are described in a 24-page illustrated "Mining Issue" of the house magazine "Production Road", issued by the Twin Disc Clutch Co. of Racine, Wis., and Rockford, Ill.

The report shows how productiveness has been increased through development of better powered equipment, and the part that improved drive links have played in increasing the power, speed, and flexibility of machinery.

How production of "more from less" is achieved through better machines for mining and transporting ores, fuels, aggregates, and chemicals, is described in pictorial articles.

Uses of hydraulic torque converters, hydraulic couplings and friction and air actuated clutches, friction and hydraulic power take-offs, reduction gears and reverse and reduction gears are shown—in shovels, cranes, draglines, drills, loaders, haulers, off-highway trucks, continuous miners, kilns, tractor-dozers, cleaning and sizing equipment, belt conveyers, compressors, aggregates plants, Diesel locomotives, oil-well drilling rigs, pumps, and pipeline laying, and pumping machinery.

Copies of the booklet may be obtained from the Twin Disc Clutch, Co., Racine, Wis.

Lattice-Braid Rod Packings

A new 8-page bulletin outlining the advantages of Lattice-Braid rod packing is available from The Garlock Packing Co., Palmyra, N. Y. The bulletin contains sectional drawings showing the unique structure of lattice-braid packings, illustrations of different types, tables showing general service recommendations and specifications, and reports from users.

Automatic Screw Machine

A bulletin describing a new No. 4 automatic screw machine, has been issued by Brown & Sharpe Mfg. Co., Providence, R. I. This new machine assures continuous, accurate production of medium-sized parts for cameras, automobiles, time fuses, and other defense items. The wide range of speeds and high-to-low speed ratios make possible highest cutting efficiency on a wide variety of materials and work diameters.

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Weightograph

A 4-page folder, Form 668, illustrates and describes the new Howe 77 Weightograph, which features a new projection type of weight indication. Twenty important features of this revolutionary automatic weighing accessory are listed along with descriptions and photographs of the unit. The Howe 77 Weightograph can be simply attached to any beam scale, or to any scale convertible to beam operation, making an old-fashioned beam scale an "automatic" of the latest type. For further information, write for a copy of Form 668, The Howe Scale Co., Rutland, Vt.

Exhaust Hood Design

A 24-page bulletin, "Manual of Exhaust Hood Design," featuring engineering data on dust-control systems for the metalworking industries has been published by the American Air Filter Co., Inc., Louisville, Ky. It illustrates and discusses the design of exhaust hoods for many operations in this field—polishing, buffing, and grinding; portable and flexible shaft grinding and polishing; cast-iron machining; automatic buffing and oil mist control. In addition to 61 photographs of actual dust-control installations showing various methods of hooding dust sources, the booklet also contains tables of exhaust requirements plus information on dust concentrations, weights of collected material, and other engineering data. Ask for Bulletin 270-El.

Tractor Tools

For the first time in the heavy machinery field a comprehensive guide illustrating the use of tractor-mounted tools in all basic industries such as railroading, construction, light and heavy logging, farming, mining, oil and gas and governmental projects has been released by Hyster Co. Printed in four colors, the brochure uses an unique cartoon style which effectively presents for the first time in one package, many of the principle uses for this type of equipment. Copies are now available from any "Caterpillar" distributor, or from Hyster Co., 2903-05 N. E. Clackamas St., Portland 8, Oreg.

Steam Traps

Armstrong Machine Works, Three Rivers, Mich., has recently issued its new "Steam Trap Book," designated as Catalog J and superseding its previous Catalog H. This 44-page catalog serves as a manual of recommended trapping practice. The publication includes: a trap catalog section containing complete physical data and list prices on Armstrong cast semisteel and forged-steel inverted bucket steam traps, compound steam traps, and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment, and a maintenance section explaining trap installation, preventive maintenance, troubleshooting, and repair.

Alloy Grain Size

A new concept of the importance of grain size in specifying sheet and strip brass, which points the way to improved alloy workability and production economy for metal goods manufacturers, is put forth in Bridgeport Brass Company's latest publication, "The 4th Dimension—Grain Size." Stressing the relation of grain size to the physical characteristics of an alloy, this 4-page folder also illustrates by microphotographs how grain structure is affected by annealing and cold rolling. Copies of the folder may be obtained from Sales Promotion Service, Bridgeport Brass Co., Bridgeport 2, Conn.

Tank Car Heater—Pumping Booster

A new four-page bulletin, Form AD-104, featuring the "Deuce"—a combination tank car heater and pumping booster, has been issued by the Cleaver-Brooks Co., 326 E. Keefe Ave., Milwaukee, Wis.

With the Cleaver-Brooks "Deuce," the bulletin explains, it is possible to raise penetration asphalts, tars, and other materials to the required high application temperatures, and deliver the material from the tank car to distributor, transfer truck, or storage tank. The unit heats and transfers material through the direct oil-fired pumping booster.

Both available models are illustrated—the mobile trailer-mounted unit and the skid-mounted unit designed for truck mounting or stationary installations.

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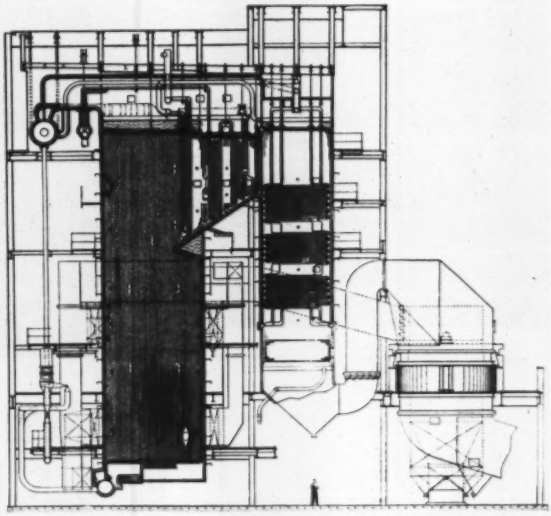

The C-E Unit shown above is one of two duplicate units now in process of fabrication for the Etiwanda Steam Station of the Southern California Edison Company at Etiwanda, California. Stone & Webster Engineering Corporation are the engineers and constructors.

Each of these units is designed to serve a 125,000 kw turbine-generator operating at a pressure of 1800 psi with a primary steam temperature of 1000 F, reheated to 1000 F.

These units are of the controlled-circulation, radiant type with a reheater section located between the primary and secondary superheater surfaces. An economizer section follows the rear superheater section and regenerative type air heaters follow the economizer surface.

Oil or natural gas firing is employed using tilting, tangential burners. The design provides for future conversion to pulverized coal when and if desired.

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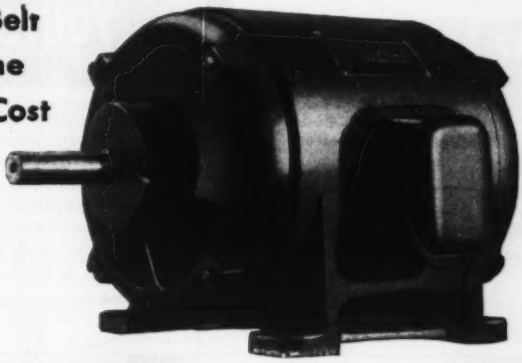

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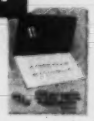
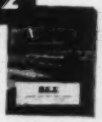
1 

Care and Maintenance of Chains—Suggestions on how to get better service with less maintenance from your conveyor and drive chains.

2 

Rex® Lumber Mill Chains—Complete descriptions with photos of all Rex Chains used in the lumber, pulp, and paper industries.

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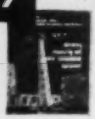
Rex Oil Field Chains—Rex and Baldwin-Rex® Oil Field Chains and other oil field products pictured and described.

7 

Rex Chains for Cement and Rock Products Industries—A description of Rex and Baldwin-Rex products used in these industries. Includes chain, idlers, conveyors, bucket elevators.

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Rex Pressed Steel Detachable Chain—A complete range of quality chains for drive and conveyor service where loads are light and speeds slow.

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Baldwin-Rex "BA" Riveted Roller Chain—Describes new riveted roller chain assembly with single pin connector for ease of assembly and disassembly.

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Baldwin-Rex Double-Pitch Roller Chains—Facts on how you can cut costs and reduce weight by specifying Baldwin-Rex Double Pitch Roller Chain.

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Baldwin-Rex Flexible Couplings—Illustrates and describes the five types of Baldwin-Rex Roller Chain Flexible Couplings.

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Baldwin-Rex Stock Roller Chains—Complete specifications, prices and descriptions of Baldwin-Rex Roller Chains, Couplings and Sprockets.

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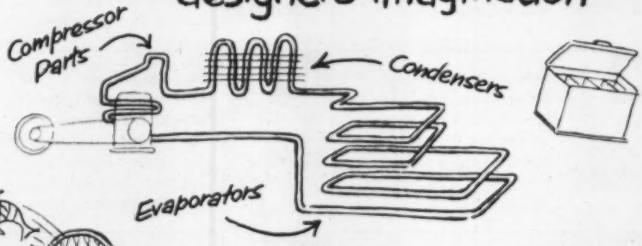

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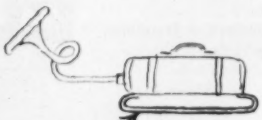

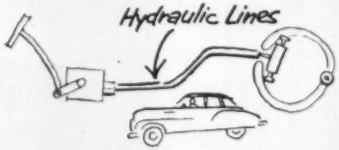

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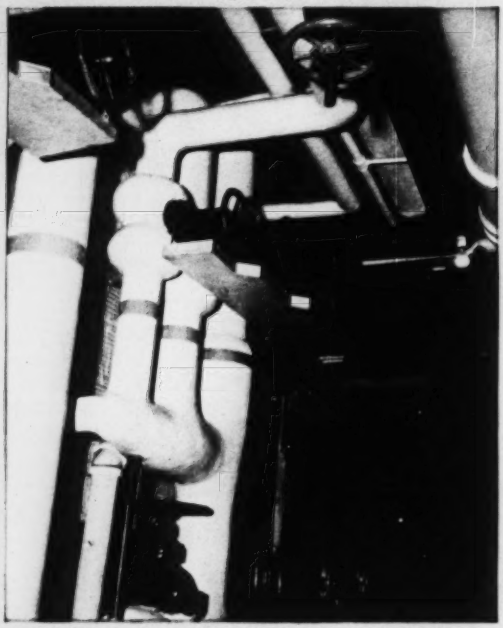
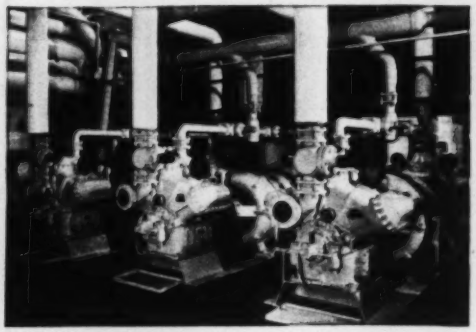
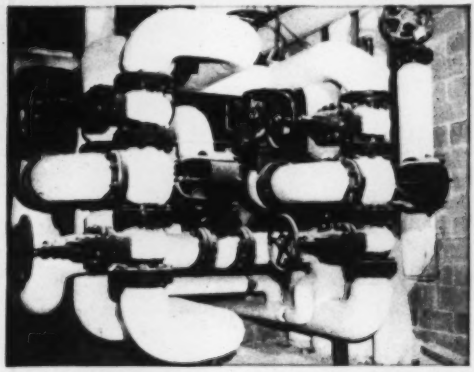


FAMOUS HOTEL—New York's Waldorf Astoria uses 160,000,000 pounds of steam annually . . . and has the most extensive air conditioning system in the world. For top efficiency, all main lines, such as this piping to a steam header, are welded. Directional changes are made with TUBE-TURN Welding Fittings. All necessary types of welding fittings for any job, large or small, can be obtained from TUBE TURNS, INC. . . . which offers the world's broadest line of welding fittings and flanges, in a wide range of types, sizes, and more than 40 different alloys.



DEPARTMENT STORE—Long known for progressiveness in the retail field, the Lazarus Company was one of the first to air condition its selling areas. Facilities have since been extended to all 32 acres of floor space. To keep maintenance to a minimum, an all-welded piping system, using reliable TUBE-TURN Welding Fittings and Flanges, was specified for refrigeration equipment, condensers, pumps, etc. Thus joints are permanently leakproof, and insulation is on for life.



HOSPITAL—All piping from 2" up, for new addition to Mount Carmel Hospital in Columbus, Ohio, is welded, with TUBE-TURN Welding Fittings specified throughout. In this maze of steam piping to a hot water converter, welded piping fits neatly into a small space. With no flanges to work around, insulation was applied easily. This leakproof piping system eliminates the danger of interruption of vital services.

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Photograph of a section of a failed tube showing excessive thinning and pitting of the outer surface. Note also the circumferential cracks.

CORROSION STUDIES CAN INCREASE THE ECONOMY OF COPPER ALLOYS

Copper and its alloys are notable for their resistance to corrosion under a wide variety of conditions. There are industrial applications where copper or the appropriate copper alloy should give an indefinitely long life, but where failure because of corrosion may result by reason of unsuitable design of equipment or improper control of environment. Further, there are many situations in which no commercial metal or alloy will have an extended life, but in which copper or one of its alloys possesses a combination of physical and chemical properties which render it the best obtainable material, when all factors, including ultimate costs, are taken into consideration. Hence correct specification becomes of great importance. Recognition of this by industry is responsible for the fact that the Revere Research Department devotes so much time to studying the corrosive effects of fluids and gases, and to preventive measures.

Recently a large manufacturer, who produces condensers as well as other equipment, reported that arsenical Admiralty tubes in a steam-jet ejector were failing after five years. This length of service is not too bad, but nevertheless such tubes often last much longer. Could we make any suggestions?

Seven failed tubes were examined for type of corrosion, metal and scale analysis. The facts were: outer surfaces were badly pitted and grooved with holes completely through in some areas; the inside surfaces were relatively untouched; cracking was circumferential, progressing from the outside; outer scale was largely cupric carbonates and copper sulfide; inner scale was calcium carbonate, cuprous oxide and some iron oxide. Microscopic examination of the cracks showed they originated in corrosion pits on the outside, progressing inward across grain boundaries, rather than along them. The transgranular path of fracture, together with other characteristics of the microstructure, definitely established the fact that the failure was of the corrosion-fatigue type. The corroding pits on the outside created stress concentration points of weakness, from which the cracks originated. Eventually the localized stress exceeded the endurance limit of the metal and it cracked.

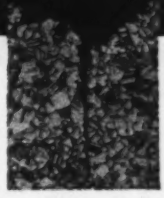
The conclusion was, therefore, that damage was from two sources—the first being excessive carbon dioxide and the other non-condensable gases in the steam, which caused the excessive pitting and thinning. It is not ununusual to have these and other corrodants present in damaging amounts in the air-ejector system, whereas they are not injurious elsewhere. The second cause of failure was excessive vibration somewhere in the unit which was responsible for the corrosion fatigue failure.

RECOMMENDATIONS. The copper-base tube alloy that generally possesses the greatest resistance to the non-condensable gases responsible for the corrosion of the Admiralty tubes is 5% aluminum bronze. Re-tubing with this was suggested. It was also recommended that steps be taken to effect a material reduction in tube vibration by placing a baffle in the steam inlet. In addition, it was pointed out that many operators find it good practice to discharge the after-condenser drain to the sewer instead of returning it to the system. By this means, the amount of carbon dioxide, ammonia and other gases in the system can be substantially decreased.

* * *

It is interesting to note that the Revere Research Department, located in Rome, N. Y., was able to determine these causes and suggest remedies without ever having seen the condenser. This is the result of modern equipment, and long experience in studying the problems of corrosion. If you have a problem regarding the corrosion of copper and copper alloys, or aluminum alloys, why not take it up with the nearest Revere office? Remember, corrosion that is too rapid wastes both your money and our national resources.

Here the circumferential cracking of the outer surface can be seen.



Photomicrograph of a section through a tube showing transgranular corrosion-fatigue crack originating from the base of a pit on the outer surface of the tube. Magnification 225X. All photographs taken by the Research Department of Revere.

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"Besides cutting our testing time by 10%, the new G-E hand tachometer has proved to be the only speed-measuring instrument which we have that will give an accurate and instantaneous reading," reports Yale and Towne, manufacturers of materials-handling equipment.

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Employing a unique electrical-reactance principle, the hand tachometer has a high accuracy of ±1% under all conditions. It is designed for long life and low maintenance. Because the hand tachometer consists of two parts—the indicating unit and a head connected to the indicator by a flexible cable—it is easy to make measurement in normally inaccessible places. The indicator can always be held in easy-reading position while the small head is held against the rotating part.

LOW COST

Measuring ranges for rotational speeds are from 100–10,000 rpm in three ranges, and linear speeds from 20–10,000 fpm in six ranges. High and low-speed adapters are available extending the range from 10–100,000 rpm. Price, complete with case and accessories is $118.01*.

Vibration Recorder Prevents Costly Machinery Breakdowns

According to a large New England manufacturer, the G-E portable recording vibrometer helps protect them from costly, emergency shutdowns of their punch presses. By analyzing the permanent record of machine vibration provided by the vibrometer, their engineers are able to determine what preventative maintenance is necessary before serious damage is done.

The recording vibrometer measures and records frequency, displacement, and waveshape of mechanical vibration. Both steady-state and transient vibrations are thus obtained and the record is

available for future study and comparison. Common applications include vibration checks of bearings, shafts, gear trains, and etc.

WIDE RANGE

The G-E vibration recorder will measure frequencies ranging from 10 to 120 cps having amplitudes from 5 to 125 mils with 0 to 20 G acceleration. It is accurate to within 5 per cent. Price is $432.12*

1952 CATALOG

G-E Measuring Equipment

80 pages describing all of General Electric's testing and measuring devices. For free copy check GEC-1016 in coupon at right.

Measure Vibration Easily with G-E Light-Beam Vibrometer

Indispensable for vibration testing of reciprocating or rotating equipment is the G-E light-beam vibrometer. Easy to use, this vibrometer indicates immediately points of excessive vibration in machinery or buildings.

The photograph above shows the portable lightbeam vibrometer being used to check the vibration at the critical speed of a motor being tested in a large eastern electrical manufacturing plant.

RANGE

The vibrometer is available with either of two scales: 0–15 or 0–30 mils. It is accurate to within 3% of full scale and is responsive to frequencies of from 15 to 250 cycles per second. Price is $233.22.*

* Mfg. suggested retail price.

SECTION B 605-24, GENERAL ELECTRIC
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Please send me the following bulletins: Indicate:

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☐ Hand Tachometer GEC-241
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☐ 1952 Catalog GEC-1016

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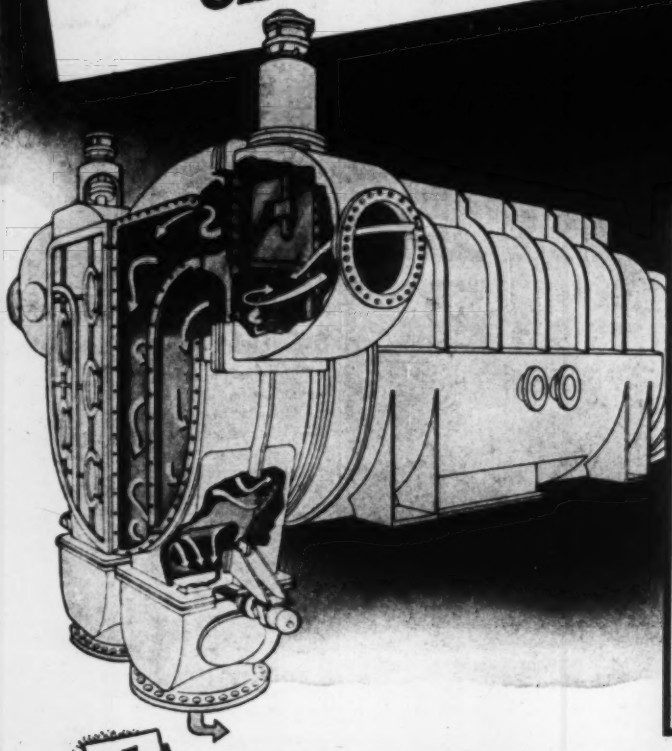
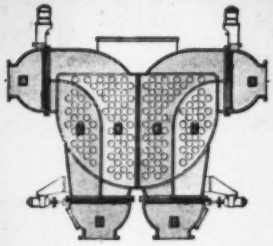
GENERAL ELECTRIC

Here's a 3-WAY "ASSIST" On Your Power Plant Problems





HERE IS HOW REVERSE FLOW WORKS

Reverse flow sluice gates on divided water box condensers work the same in both halves but independently of each other. Right side: normal flow. Water enters divided water box in valve chamber "A" with lower port open. It flows through pass "C" to end of condenser, back through pass "B" and out through left port of "D."

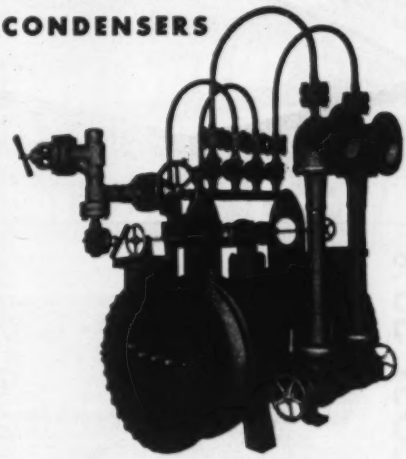
Left side: flow is reversed. Valves at inlet "A" and discharge "D" are changed to permit water to flow through "B" and back through "C" in the opposite direction and then out through the left port of "D."

1 CLEAN DEBRIS FROM CONDENSER TUBE SHEETS WITHOUT DOWNTIME OR LOSS OF VACUUM

C. H. Wheeler "Reverse Flow" Condenser design provides a powerful self-cleaning flushing force by the simple procedure of reversing the flow of water through the tubes. Electrically or hydraulically controlled sluice gates accomplish in minutes cleaning that consumes hours of downtime when removal of debris is done by hand. Power plant modernization calls for the efficiency and uninterrupted operation of C. H. Wheeler "Reverse Flow" Condensers. You don't need costly water straining apparatus. Send for latest bulletin #410.

2 VACUUM PUMPS WITH LOWEST MAINTENANCE FOR YOUR STEAM CONDENSERS

C. H. Wheeler Steam Jet Ejectors are the development of 35 years of pioneering in this field. Known as "Tubejets," these vacuum pumps have no moving parts. Hence, they are simple to operate, require almost no maintenance and last longer. Modern Power plants use single or two-stage Tubejets with surface inter-after condenser for the vacuum requirements of steam condensers. Special arrangements of standard Wheeler ejector assemblies can be provided for any unusual installation or performance requirements. Catalog #1462 gives you detailed descriptions and some useful temperature and pressure conversion tables. Write for it.



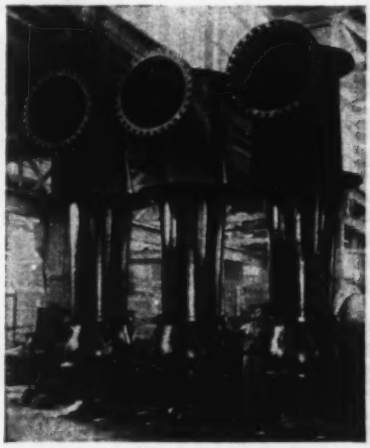
SPECIAL TYPE TUBEJET VACUUM PUMP FOR HIGH PRESSURE AND HIGH SUPERHEAT

3 WHEELER-ECONOMY CIRCULATORS HANDLE LARGER VOLUMES OF WATER AT LOWER COST

Wheeler-Economy Pumps for Condenser Cooling Water Circulation are made in horizontal double suction and vertical submerged, axial mixed flow types. These pumps are noted for reliability, the result of superior modern design and heavy duty, quality construction. They are built in all sizes to meet capacity requirements up to 200,000 GPM. Wheeler-Economy Circulating Pumps are also furnished in special metals to handle corrosive waters. The impellers are designed for satisfactory operation during all load requirements.

Economy engineers are pioneers in the successful application of axial flow pumps in circulator service. These pumps can be furnished in "pull-out" type with distinctive design features, permitting removal of all operating parts, without dismantling the complete pump or disturbing any pipe connections.

For top performance in power plant duty count on Wheeler-Economy Pumps. Write for catalogs #G-349 and G-1050.



THREE CIRCULATORS OF 28,000 G.P.M. CAPACITY. 35 FT. TDH, 575 RPM.

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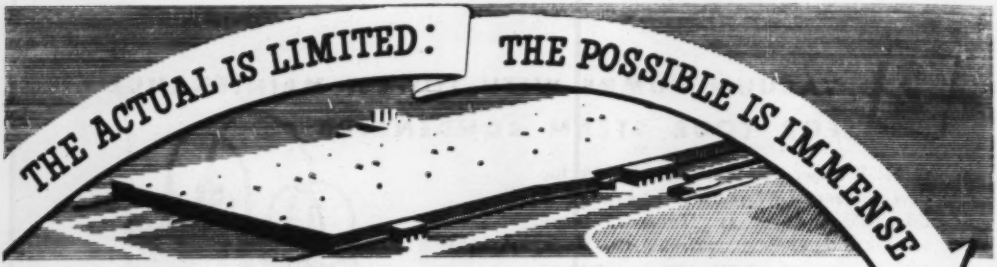

NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

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WELDED STEEL SIMPLIFIES CONSTRUCTION IMPROVES PERFORMANCE, CUTS COST 33%

By **Russell M. Roberts**, Chief Engineer,
Parks Woodworking Machine Company, Cincinnati, Ohio

Changing over our band saw frame to welded steel design has simplified many production problems while cutting costs by one third.

The original cast construction (Fig. 1) called for machining a complicated casting on which foundry rejections were common. The present welded steel design utilizes simple square tubing, sawed to size, clamped in a plain fixture and butt welded. The efficient use of steel has cut weight by 37% while increasing strength and rigidity.

An added benefit, made possible with welded design, now permits independent leveling of the work table that formerly could be accomplished only through a major adjustment of the frame itself.

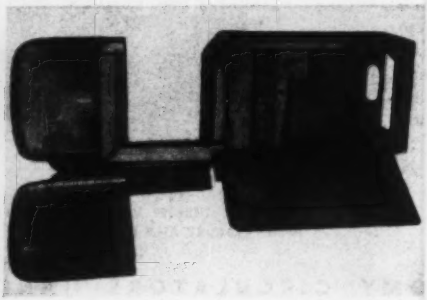

Fig. 4—All Welded Steel Frame *for the Parks Woodworking Machine Co., Cincinnati, Ohio. Sides are brake formed from 12 gauge metal.*

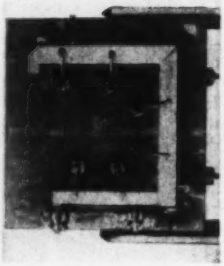

Fig. 3—Simple Jig *for welding square steel tubing components consists of clamps and locating pads.*

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Complete training course for designers and production engineers now available for presentation in your plant. Send for complete details.

PROPER DESIGN IN WELDED STEEL ALWAYS IMPROVES PRODUCT, LOWERS COST

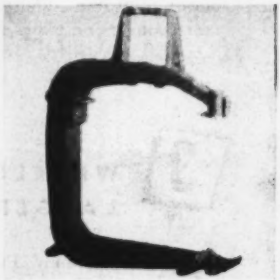

Fig. 1—Original Construction— *Machine bracket formerly weighed 56 pounds, was difficult to cast, high cost incurred from excessive rejects.*

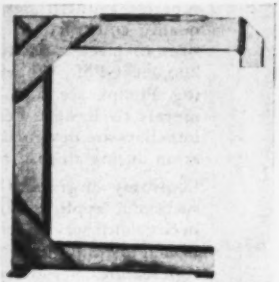

Fig. 2—Welded Steel Design *is stronger, more rigid yet weighs only 35 pounds. Weldment costs 33% less than original casting. Eliminates considerable time in machining and assembly.*

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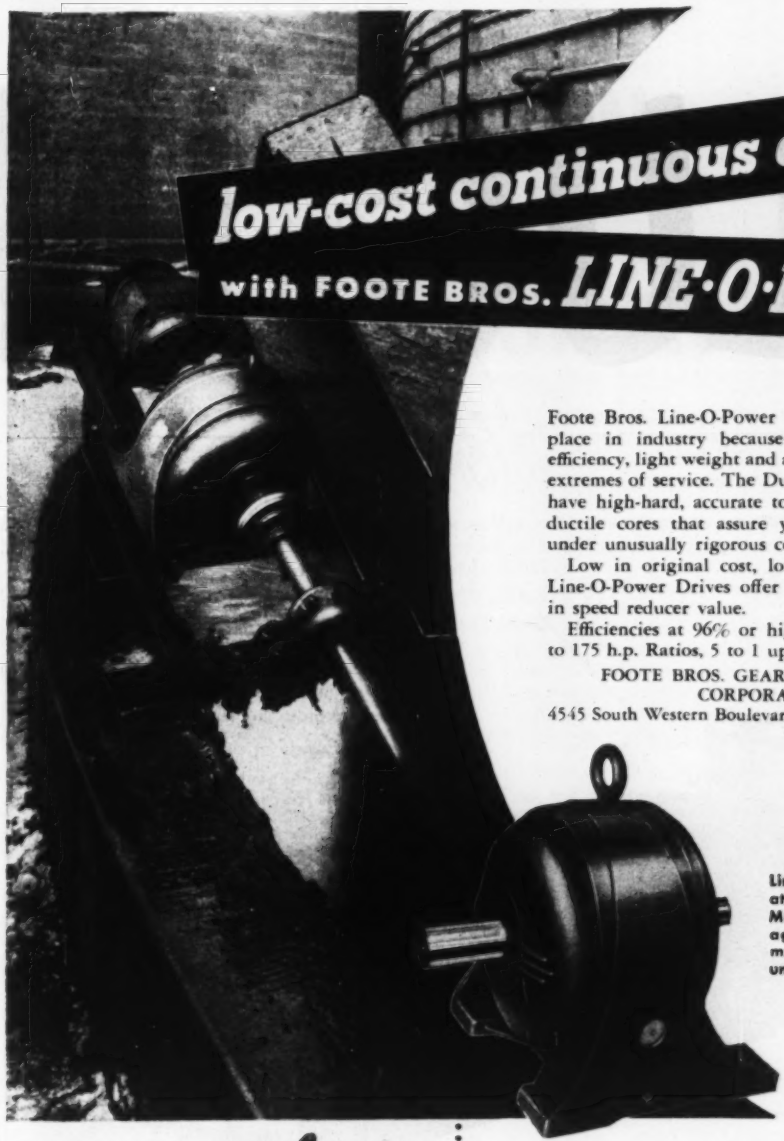

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Efficiencies at 96% or higher. Capacities from 1 to 175 h.p. Ratios, 5 to 1 up to 238 to 1.

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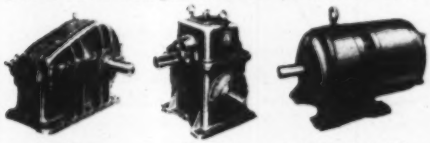

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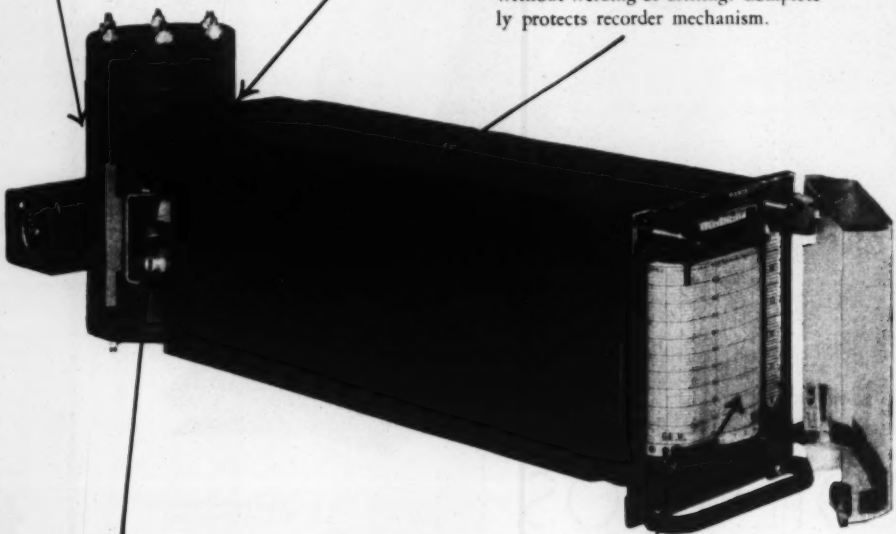
The plug-in controllers can be removed and replaced with another unit in just 10 seconds.

One common, self-sealing manifold gives plug-in connections to both receivers and controllers!

Rugged steel sleeve clamps on panel, without welding or drilling. Completely protects recorder mechanism.



The only piping on the panel back are lines from the transmitter, air supply and controller output. Units can be mounted just a few inches apart.

Recorder or indicator plugs in from the front—units can be interchanged in just 10 seconds.

THE NEW IDEA IN PANEL INSTRUMENTATION

Taylor, pioneer in the 3-part control system brings many new refinements based on extensive field experience

1. Change from simplest to most complex control by simply pulling out one unit, plugging in another.

2. Change from indicator to recorder or vice versa in only 10 seconds.

3. One mounting for both controller and receiver—recorder or indicator.

4. Recorders or indicators can be mounted on the panel without welding, without drilling holes.

5. Only piping connections required are air supply, controller output, and to variable transmitter. All other connections made automatically in self-sealing manifold.

6. All adjustments can be reached without disturbing any connections.

7. Mountings are extremely simple and rugged.

8. You save panel space by mounting units a few inches apart.

9. Receiver mechanism totally enclosed by protective sleeve.

10. You save money on installation—thanks to simplified piping and mounting.

Be sure to get information on the new and greater plug-in type Taylor TRANSET Control before you make any decision involving pneumatic transmission control. Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.

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Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

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ADDITIONAL NEW FEATURES IN TAYLOR'S TRANSET® RECORDER:

Continuous valve position indication on separate scale tells valve pressure at a glance.

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New chart drive mechanism for greater convenience, greater dependability.

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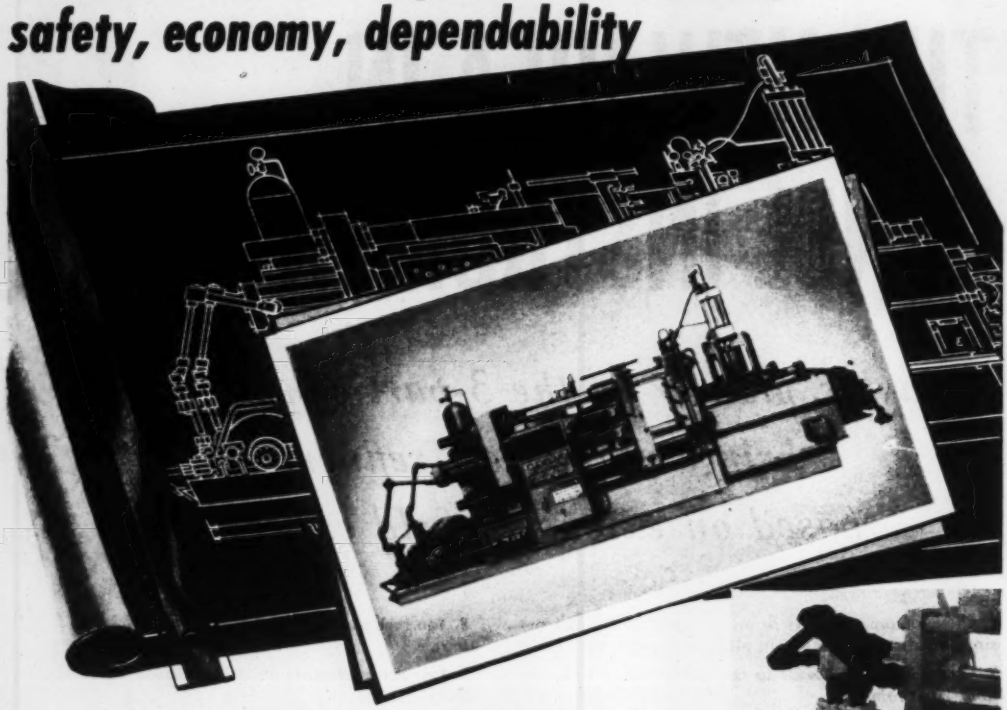

CHIKSAN speeds the flow of industry when

THE DIE IS CAST

BY CLEVELAND AUTOMATIC

When industry wants better castings, faster, for lower cost it turns to the Cleveland Automatic Machine Company to furnish high pressure hydraulic die casting equipment. Cleveland is an old hand in making dependable machines that turn out precision castings to keep the wheels of industry humming.

Cleveland, in turn, relies on Chiksan Ball-Bearing Swivel Joints and Chiksan engineering to supply the flexibility, safety, dependability and economy needed in handling high pressure hydraulic oil—transforming metals to essential parts for industry's forward march.

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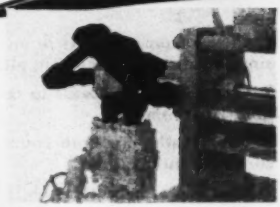
The whole range of industry looks to Chiksan to supply a blueprint for progress in the better, safer, more economical task of conducting liquids and gases through freely flowing lines—under great extremes of temperature and pressure—in the most difficult or complex manufacturing conditions and procedures—with uninterrupted flow—with low maintenance—with precision and profit.



• High Pressure (Chiksan) Ball-Bearing Swivel Joints on the die locking end permit adjustment of die space and insure a leakproof hydraulic system.

• High Pressure (Chiksan) Swivel Joints are standard equipment in hydraulic lines of all hot chamber machines to allow for adjustment of the shot cylinder assembly and at the same time eliminate all fire hazard.

• (Quoted from the manual that Cleveland has issued about the Model 400 Die Casting Machine—emphasizing importance of Chiksan Ball-Bearing Swivel Joints.)

The Flow of Enterprise Relies on **CHIKSAN** *Ball-Bearing Swivel Joints*

CHIKSAN

Representatives in Principal Cities
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CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 28, Illinois • Newark 2, New Jersey

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Now . . . Longer Life Between Gauge Cleanings

with the NEW and IMPROVED

"HI-LITE"
ILLUMINATOR

for DIAMOND
Bi-Color Gauges

Steam shows RED an empty glass is entirely RED

Water shows GREEN a full glass is entirely GREEN

Using lamps similar in general construction to "sealed beam" automobile headlamps, the new Diamond "Hi-Lite" Bi-Color Gauge Illuminator is a definite improvement over previously used sources of light. This type lamp has a reflector sealed inside where it cannot get dirty. The face of the lamp is easily accessible for cleaning . . . as are all other parts of the illuminator.

A very high level of illumination is maintained throughout the long life of the lamps. This provides greatest possible color contrast at water level . . . permits longer time between gauge cleanings, therefore reducing maintenance. The gauge remains easily and clearly readable when dirty mica would otherwise make reading difficult.

The Diamond Bi-Color Water Gauge makes use of an unvarying optical principle to show water green . . . steam red. With proper illumination, water level is unmistakable . . . whether viewed directly, or through a system of mirrors, or on control panel by use of Diamond "Utiliscope" (Wired Television). Ask for new Bulletin No. 1051.

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LANCASTER, OHIO
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GREATER COLOR CONTRAST AT WATER LEVEL

EASY ACCESSIBILITY FOR QUICK MAINTENANCE

REDUCED MAINTENANCE COSTS

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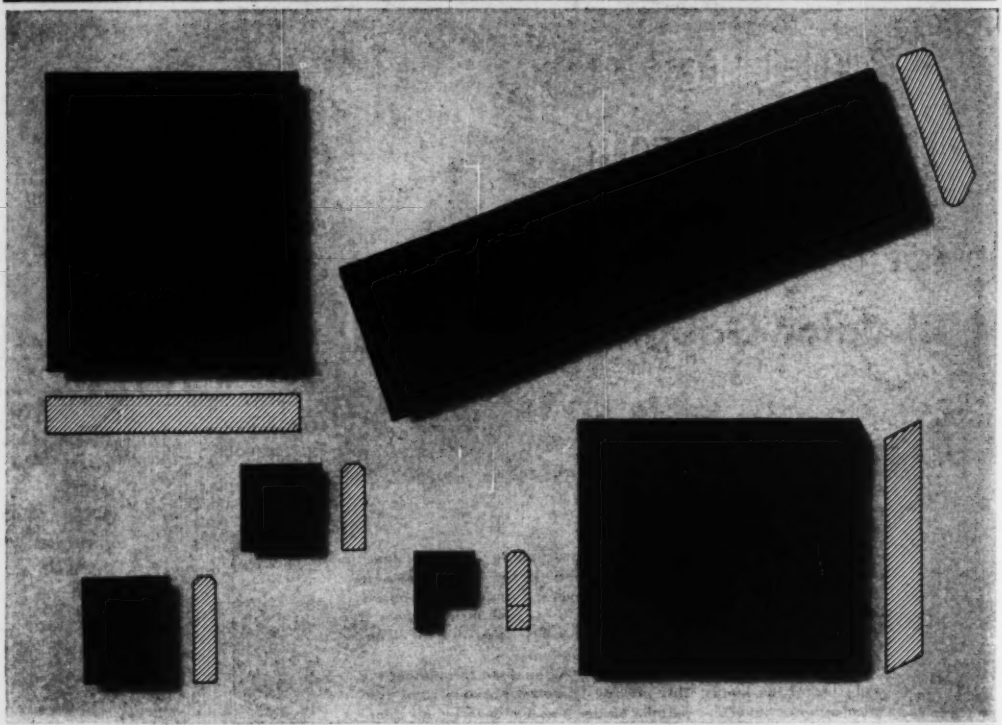

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HEAT RESISTANCE • SELF LUBRICATING • WEAR RESISTANCE • CORROSION RESISTANCE

LOW LIGHT BILLS... mark phenomenal acceptance of "EVEREADY" No. 1050 Industrial Flashlight Batteries by a broad cross-section of industry. Delivering twice the usable light of any battery we've ever made before, it will not swell, stick or jam in the flashlight . . . has no metal can to leak or corrode.

● "National" Carbon Rotor Vanes for pumps and compressors are precisely machined and finished from a special carbon-base material which provides a combination of properties unmatched by any other kind of material for this service.

Precision machined to your blue-print specifications, "National" Rotor Vanes are your answer to tough operating problems such as corrosive liquids and gases, high temperatures, case-galling, warpage and other sources of frequent and costly maintenance.

Engineering assistance in the design and the application of "National" Rotor Vanes is available through our district offices listed below.

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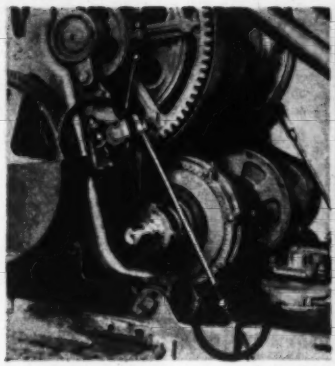
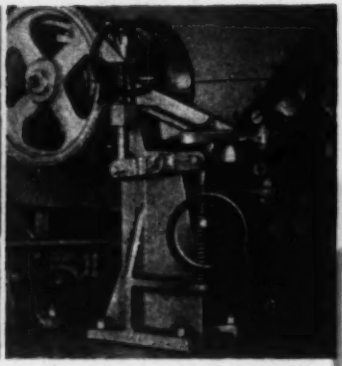
For a nut that won't vibrate out of adjustment



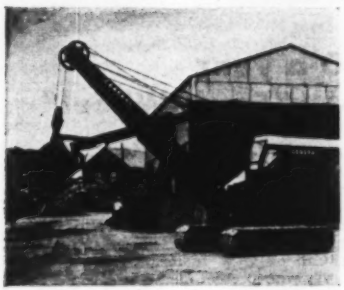
LOCKS ANYWHERE . . . Spring-loaded reach-rod and stop lever on this new General Excavator shovel depend on Elastic Stop Nut's positive gripping action. The elastic collar permanently positions the nut anywhere on the bolt to accurately maintain spring-loaded settings.

VIBRATION-PROOF . . . Idler tumbler on this new shovel must maintain constant tension against crawler belt. An Elastic Stop Nut holds it firm in the face of vibration and heavy impact loads. The Famous Red Elastic Collar hugs threads, damps out vibration.



EASILY ADJUSTED . . . On applications like these, General Excavator has provided its customers with the easy, sure method of adjustment—Elastic Stop Nuts. These nuts take hair-fine adjustment in the field or in the factory—and hold it indefinitely.

use Elastic Stop nuts



This newest earth mover of the General Excavator Company is 100% equipped with Elastic Stop Nuts. At 750 key spots General Excavator simplified assembly with these standard fasteners—offers customers less maintenance, easier maintenance.

Elastic Stop Nuts are supplied with integral locking collars of nylon or fiber—permit multiple reuse—have military, naval, and air force approvals. For design information on Elastic Stop Nuts, contact your local ESNA representative, or mail the handy coupon to Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, N. J.

Elastic Stop Nut Corporation of America is also maker of the ROLLPIN

Dept. N3-911, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, N. J.

Please send me the following free information on ESNA self-locking fasteners:

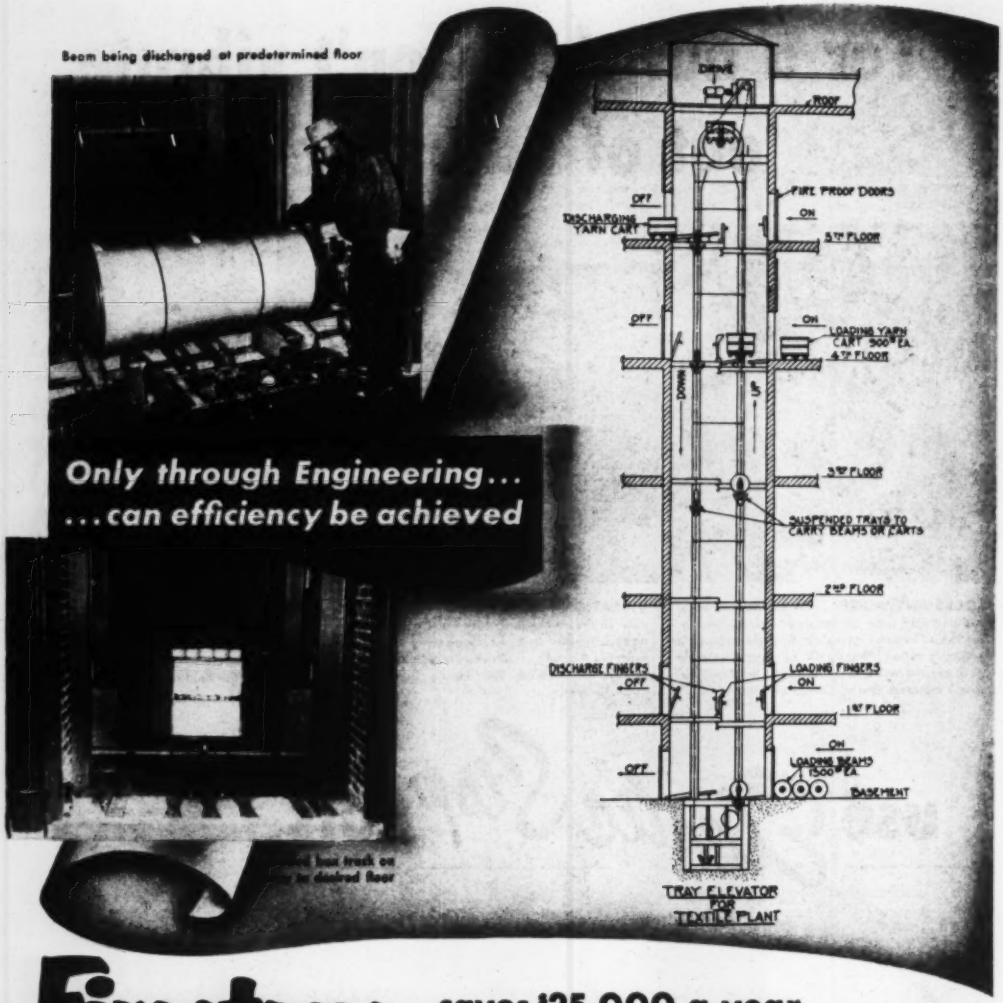
☐ AN-ESNA conversion chart
☐ Elastic Stop Nut Bulletin
☐ Rollpin bulletin and sample Rollpins
☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name _____ Title _____

Firm _____

Street _____

City _____ Zone _____ State _____



Firestone saves $25,000 a year with this G-W "Ferris Wheel"

Moving 1300-lb. beams of rayon and 900-lb. box trucks in and out of freight elevators is a back-breaking job. Yet approximately 230 of these bulky loads must be lifted (and empties returned) every day at the Firestone Textiles Division of the Firestone Tire and Rubber Co., Gastonia, N. C.

This Gifford-Wood "Ferris Wheel"—a 6-story roundabout tray elevator—has assumed most of the work load. Beams and trucks are automatically picked up on the loading side of a shaftway by trays suspended between two endless chains, carried to the top, eased over the drive sprockets, lowered to the desired floor, and automatically discharged.

The $25,000 annual saving is basically one of reduced labor requirements and improved handling efficiency, and the limited manual work remaining is much less strenuous than formerly.

This is just one of many conveyors born of G-W ingenuity and experience—a product of efficiency through engineering. Call on G-W Materials-Handling Engineers to survey your present methods; you are under no obligation. It might well prove to be a step toward higher profits through lower operating and maintenance costs.

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use these American Standard specifications and procedures for gear design, manufacture, and inspection.

INSPECTION OF FINE PITCH GEARS, B6.11—1951 $2.50

This American Standard shows how to determine, before assembly, whether a mechanism employing gears of 20 diametral pitch or finer will function properly. In its pages will be found specifications for backlash and tolerances; the procedures for making comparator layouts and photographic negatives to desired scale; requirements for machining gear blanks; gear blank terms; pin measurements, directions for using master gears; and classifications of various degrees of surface roughness, waviness, and for several varieties of lay.

DESIGN FOR FINE-PITCH WORM GEARING, B6.9—1950 $1.50

This is a design procedure for worms and worm gears with axes at right angles, comprising cylindrical worms with helical threads, the worm gear being hobbed for fully conjugate tooth surfaces. It supplies the standard proportions of worms and worm gears, values of diameter for all possible combinations of leads and lead angles within the Standard, and tooth proportions based on normal pitch for all combinations of standard axial pitches and lead angles. An extensive table gives the difference in departure from a straight side of the worm profile and the changes in pressure angle produced by cutters or grinding wheels of 2-in. and 20-in. diameters.

FINE-PITCH STRAIGHT BEVEL GEARS, B6.8—1950 $1.00

This standard covers generated straight bevel gears of 20 diametral pitch and finer, for all shaft angles, and with the numbers of teeth equal to or greater than 16/16, 15/17, 14/20, 13/30 for 90-degree shaft angle. Also given are the general specifications, nomenclature, symbols, the tooth proportions for 1 diametral pitch, gear blank dimensions and tolerances, and the fine pitch straight bevel gear dimensions.

GEAR NOMENCLATURE, B5.10—1950 $1.50

This standard lists and defines the 179 terms commonly used in gear engineering. For convenience of users, terms are grouped in sequence to indicate their close relationship. Eighty-six drawings illustrating the terms.

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20-DEGREE INVOLUTE FINE-PITCH SYSTEM FOR SPUR AND HELICAL GEARS, B6.7—1950 $1.50

This is the Standard to consult for standard tooth proportions, tool parts; dimensions of enlarged pinions; gear dimensions, recommended minimum number of teeth in the gear for the standard center-distance system and the center-distance increase for the enlarged center-distance system; data showing permissible reduction in outside diameter of gears from 20 to 200 diametral pitch; data covering design of spur and helical pinions having 9, 8 and 7 teeth; formulas used in calculating the values in the various tables; and definitions for all symbols used.

LETTER SYMBOLS FOR GEAR ENGINEERING, B6.5—1949 50¢

This system of symbols and subscripts is generally consistent with those appearing in other American Standards, and follows the same general principles. There are over 140 symbols in the collection grouped under two headings—general and special. Other lists indicate: the allocation of the letters of the English alphabet for gear engineering symbols, the Greek letters employed in the Standard, and a recommended plan for subscripts.

SPUR GEAR TOOTH FORM, B6.1—1932 55¢

This standard provides the proportions of the American Standard tooth form for 14½ degree composite system, 14½ degree full depth involute system, 20-degree full depth involute system and 20-degree stub involute system. Data are presented for obtaining full involute tooth action on pinions of 31 teeth and smaller when using the 14½ full depth involute system, and on pinions of 17 teeth or smaller when using the 20-degree full depth involute system.

GEAR TOLERANCES AND INSPECTION, B6.6—1946 80¢

These tolerances apply to spur, helical, bevel and hypoid gears. The diameters considered are from 3/4 to 100 inches. The pitches range from 1 to 32 diametral pitch. The fundamental errors for which tolerances are given are defined and explained briefly. Allowances and tolerances for backlash are also treated.

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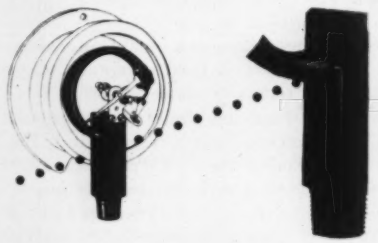


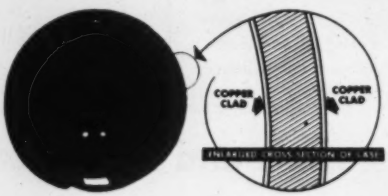
Socket, tube, and end-piece fused into one-piece unit —The problem in every pressure gauge has always been to make permanently leak-tight joints from the inlet to the tip of the bourdon tube.

Marsh construction has always provided the utmost in leak-tight assemblies. But just as welded piping is always more sound than the best joined piping, the fusing of the assembly into an integral unit reduces the possibility of leakage to the vanishing point.

It required extensive research to develop a method of welding the parts into a one-piece unit, but a special process has now been perfected. The result is known as

the "Canoweld" Tube

After fusing, the tube is accurately tempered to required resiliency. The unretouched photo of a socket sawed in half shows the perfect fusion of the joint most difficult to make — the joint where the tube enters the socket. Photomicrographs are available to prove the perfection of the process.



Four times as strong and one-third lighter than a cast iron case — This copper-clad, wrought steel case of boiler plate thickness has the advantages of any type of case — without the faults. It is known as

the "Marshalloy" Case

This case is four times as strong and one-third lighter than conventional cast iron cases. The copper surface makes it as non-corrosive as a plastic or die-cast case. It is finished in a newly developed corrosion-resistant satin black enamel that makes it as attractive as it is durable. Fitted with Marsh safety blow-out plug, it sets a new standard in gauge housing.

THE Marsh developments presented here unquestionably represent the two greatest contributions to pressure gauge accuracy and stamina in recent years . . . the most important advancements since the introduction of the Marsh "Recalibrator."

These improvements take on all the more significance from the fact that they are contributed to the line of gauges that has become the symbol of gauge accuracy and permanence . . . the Marsh "Mastergauge" line.

Foremost and most basic of these improvements is the fusing of the socket, tube, and end-piece into the equivalent of *one-piece* construction. Marsh Methods have always achieved the utmost in leak-tight construction, but here is something still better: the joints are *eliminated!*

Second only to the one-piece socket, tube, and end-piece is that new "Marshalloy" copper-clad case. It is a case that retains all advantages of all kinds of cases; eliminates all the faults.

Read the facts opposite and you will see how the finest line of pressure gauges has been made still better.

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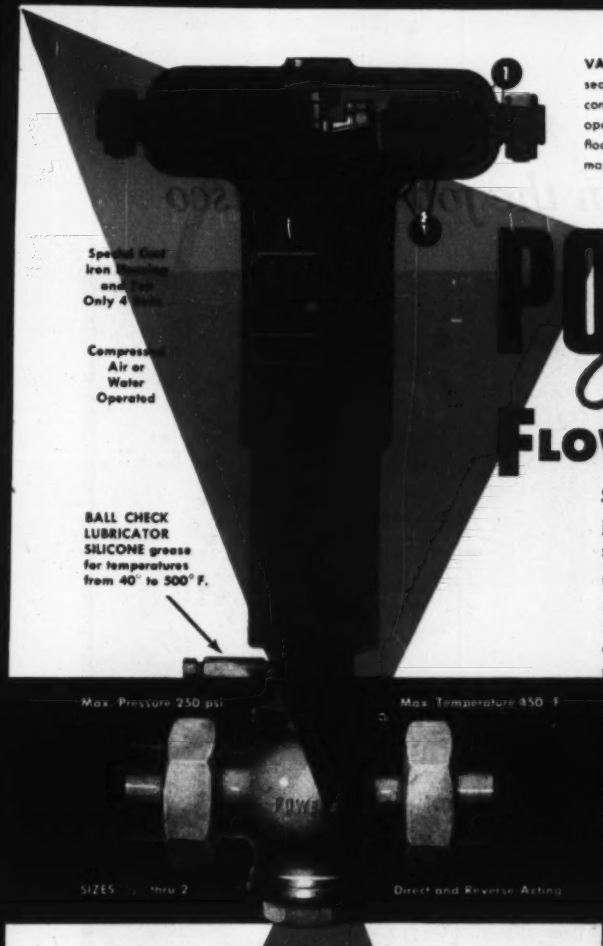
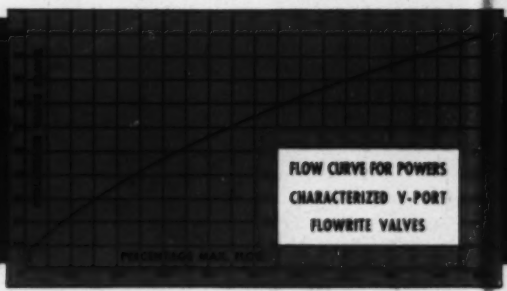


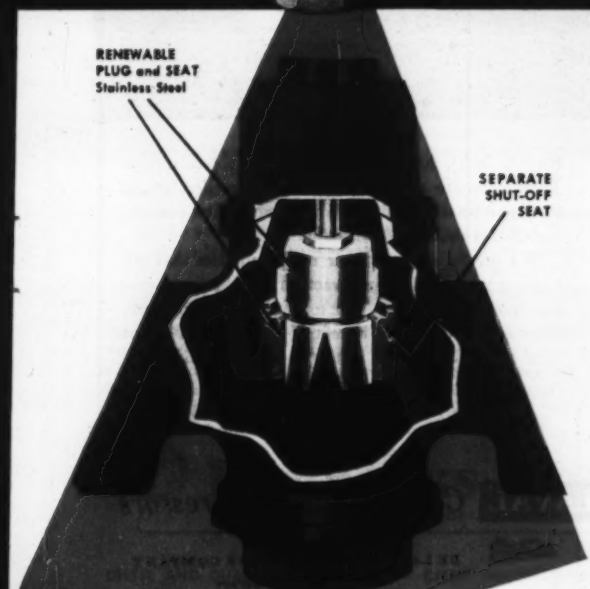
VALVE TOP—Durable moulded neoprene diaphragm (1) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (2) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment. Maximum air pressure in top, 22 psi.

POWERS® SINGLE SEAT V-PORT *Characterized* FLOWRITE VALVES Give—

Special Flow Characteristics—High lift V-Port plug provides proportional flow throughout entire lift of stem as shown in chart below.

Wide Variety of Valve Sizes—Nine sizes are available, ½" thru 2". The ½" valve can be furnished with plugs to give 15%, 30%, 60% or 100% of maximum capacity. Plugs are easily interchangeable without removing valve from line.





Better Control—Less Maintenance—Superior design of stainless steel plug and seat reduces wire drawing, insures longer life and tight shut off. V-Ports do the throttling, protecting separate shut off seat. Plug and seat are truly removable and can be easily replaced in the field. Inner valves are machined and precision ground and lapped within very close tolerances.

Low Hysteresis—Due to smooth rolling diaphragm and polished stainless steel stem in preformed lubricated packing.

Easy to Adjust—Ball bearing adjusting screw; rust proofed steel calibrated springs with full travel in 5 or 10 psi.

Easy to Install—Powers Flowrite V-Port valves have double unions and bronze body with rugged construction to withstand piping strains.

Easy to Service—Valve and top are easy to take apart and re-assemble, facilitating inspection and maintenance.

Reasonably priced. Contact our nearest office for prices and assistance in selecting proper size valves

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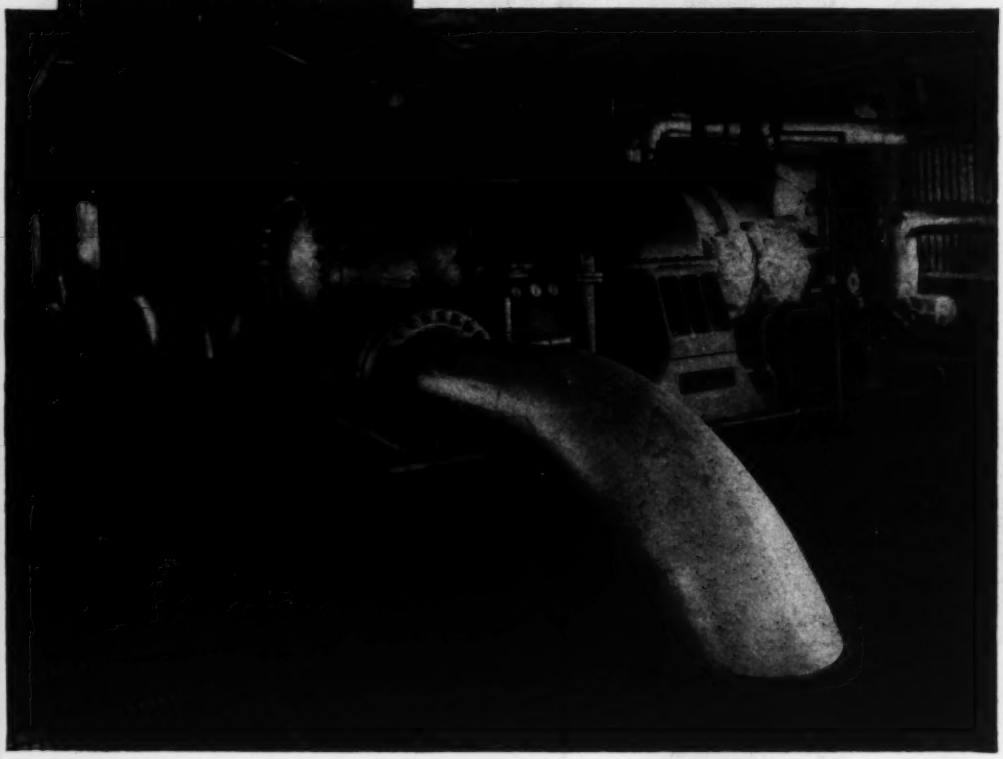

Today's modern, long-distance, high pressure gas transmission lines can't afford weak links. That's why the Transcontinental Gas Pipe Line Corporation selected these three efficient De Laval 5,000 hp steam turbine-driven centrifugal compressors for their Tylertown, Mississippi station.

There are sound reasons for their selection. The De Laval high pressure shaft seal eliminates leakage. Consumption of sealing oil is negligible. There is only one moving part—the rotor, which has ample clearances. These units are also compact, require smaller foundations and smaller stations. What's more, first cost and installation costs are low.

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R-S valvEvents

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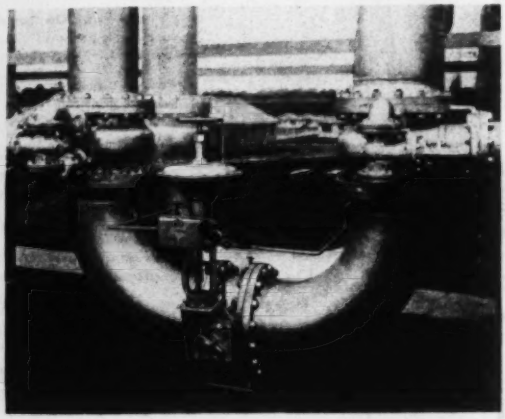

R-S Automatic Valve installed on water jacket to gas engine in gas booster station.

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R-S Valves are used in air, gas, liquid, steam, and semi-solid service for the shut-off and regulation of volume and pressure, pressure relief, liquid level control, back pressure, water hammer, steam hammer, constant differential pressure, and the output control of pumps, fans, engines and turbines. Suitable for service in the temperature range from minus 300° to plus 2000° F. 2 to 2500 psig.

Simplicity of design, ease of operation, positive rubber seat shut-off, and the wide range of application indicate the high order of metallurgical and mechanical engineering that is embodied in every R-S valve.

Consult your local R-S Valve Engineers, or write direct.

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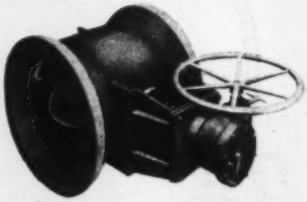
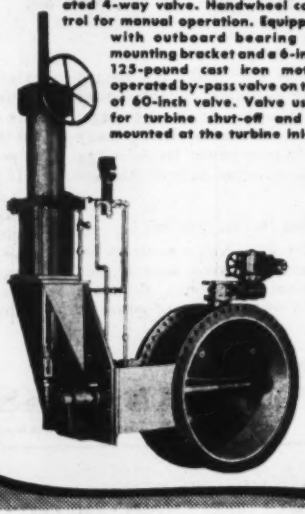


No. 836—24-inch 125-pound cast iron hub-end valve with bronze liner and monel periphery on vane for water service. Equipped with totally enclosed gear reducer, handwheel and locking device.

No. 801—3-inch 125-pound bronze screwed-end valve with handlever control and locking device.

No. 828—60-inch 150-pound cast steel valve with 18-8 shafts, bronze bushings and bronze body liner. Cylinder operator is controlled by electric motor operated 4-way valve. Handwheel control for manual operation. Equipped with outboard bearing on mounting bracket and a 6-inch 125-pound cast iron motor operated by-pass valve on top of 60-inch valve. Valve used for turbine shut-off and is mounted at the turbine inlet.



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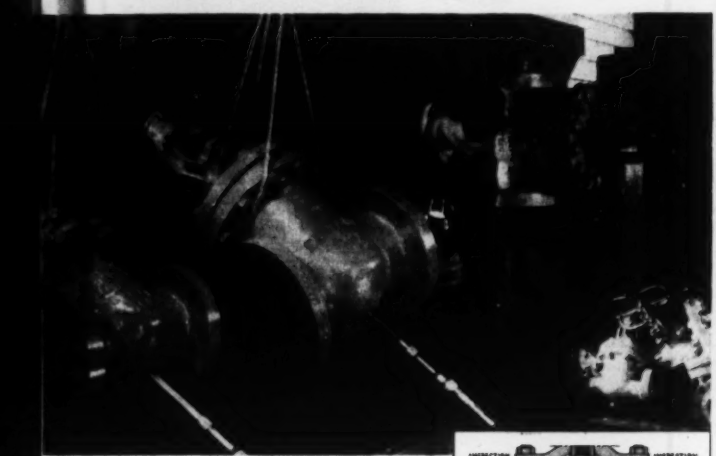
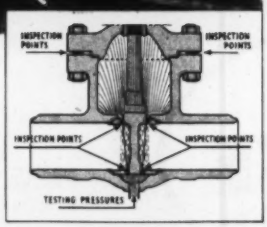
valve values
PHOTO NEWS

No Exceptions- *Every* *Edward Valve* MULTIPLE TESTED

Building components accurately doesn't necessarily insure assembled product performance. Valve tightness, for example, can be established only through rugged testing. And one test isn't enough. Tightness dependability is guaranteed only by multiple testing of every valve—each test designed to prove performance under service operating conditions. For example, the 14-in. PRESSURE-SEAL globe valve (right) designed for operation at 900 psi underwent three separate hydrostatic tests for soundness of pressure containing parts and tightness of bonnet joint and backseat. The Fig. 444 globe valves above, designed for 600 lb, were subjected to a 26 step test procedure including hydrostatic pressure of 3000 psi before receiving an O.K. for shipping release. Every Edward valve from tiny ⅜ in. gage valves to largest 2500 lb design must fully meet test requirements. There are no exceptions or tolerances in Edward testing standards.



Many test procedures are exclusive with Edward. Special method of testing gate valve illustrated uses pressure injected through bottom of body to surround seat faces, yet leaves both ends open for inspection. *Both* sides of gate valve wedge must be tight simultaneously to pass test.



No guesstimating in Edward test procedures. Every test condition is controlled by precision tools and instruments. In applying load to handwheels for seat joint testing, torque wrenches are used to precisely measure allowable test torques—only 70 inch-lb to hold 6000 psi for the Fig. 952 valves pictured. Valves must be drop tight at this load to pass test.

Edward Valves, Inc. Another Product

NEW Forged Instrument Valves

FOR HIGHER TEMPERATURES AND PRESSURES

Modern instruments and controls, operating at high temperatures and pressures, require a large cash investment. Sound operating practice demands that these costly devices be protected by small stop valves designed to use at the temperatures and pressures of the fluid being measured or controlled.

Until recently there was no really satisfactory valve for this service. Small threaded bonnet valves were unsatisfactory for high temperature-pressure applications, but were often used because of the lack of a suitable bonnetless valve. Standard globe valves, satisfactory from an operating standpoint, were too bulky for crowded locations such as instrument panels.

For these services, Edward developed its Fig. 952 series instrument valves. Rated for pressures up to 6000 lb at 100 F or for 1500 lb at 1000 F, these all drop-forged steel O. S. & Y. valves completely answer the need for a high pressure, high temperature instrument valve. They are ideal for installations where space is at a premium.

It is impossible to manually damage these ruggedly constructed little valves. Yoke, gland and gland bolts are drop-forged steel for added strength. Drop-forged body eliminates the possibility of pipe seams often found in barstock construction, or internal voids prevalent in thin-walled castings. The vital body-yoke threaded connection, consisting of an external thread on body and internal thread on yoke, is completely outside of pressure area within valve.

FOR EASY PACKING
Simply remove nuts on the two swing gland bolts and position gland on yoke gland rests. Repack valves, as illustrated, with complete freedom of both hands. Generous space between stem and yoke allows quick, trouble-free repacking.

Stem of hardened EValloy, 13% chromium stainless steel, is centerless ground for smooth packing contact. Tapered, needle point disk integral with stem, plus fine pitch stem thread, allow accurate flow adjustment.

Valves are furnished in ¼", ⅜", and ½" sizes in either globe or angle types. Fig. 952-3 valves have carbon steel bodies, while Fig. 2952-3 are furnished with bodies of EValloy, 13% chromium stainless steel. (AISI Type 416 weldable.) Fig. 2952 valves are also furnished in ¾" and 1" sizes. Screwed or socket welding ends are provided.

EDWARD VALVES, Inc., *Subsidiary of*
ROCKWELL MANUFACTURING COMPANY
1350 W. 145th STREET • EAST CHICAGO, INDIANA

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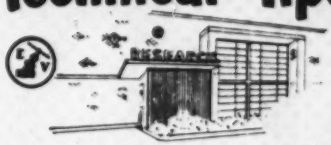
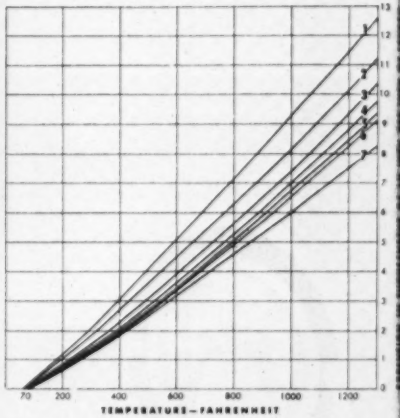
Technical Tips



What Thermal Expansion Does to Valve Materials

Coefficients of thermal expansion greatly influence the selection of modern valve materials. For example, if the thermal expansion coefficient of a valve stem is greater than that of the valve body, a valve closed tight at an elevated temperature might be less tight as it cooled off, often resulting in leakage. If, on the other hand, the thermal expansion rate of the stem material is substantially less than that of the body material, the stem will contract less than the valve body on cooling, with the result that it may not be possible to open the valve with ease. Ideally, stem material should have a coefficient of thermal expansion only 10 to 20% less than that of the body and bonnet material.



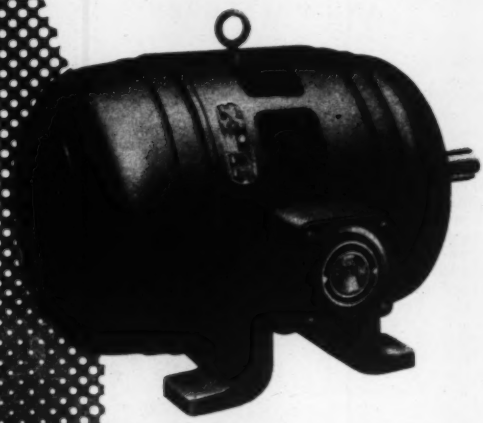
COEFFICIENT OF THERMAL EXPANSION AT TEMPERATURE OF VARIOUS VALVE MATERIALS

1. 18% Chromium—8% Nickel Stainless Steel valve trim material.
2. Monel—Valve trim material.
3. Stellite No. 6—Valve trim material.
4. A.S.T.M. A216—WCB—Carbon Steel body material.
5. A.S.T.M. A217—WC6—1% Chromium Steel body material.
6. A.S.T.M. A217—WC9—2½% Chromium Steel body material.
7. Edward EValloy—13% Chromium valve trim material.

The chart shows the coefficient of thermal expansion of several valve trim and body materials at temperatures up to 1300 F. Obviously, Edward EValloy meets the ideal thermal requirements for stem materials mentioned above. This, plus its many other desirable properties, make it the most widely used valve stem material.

Hard surfacing is an effective method of imparting resistance to abrasion, galling and corrosion to vital parts of valves. However, cracking may occur if the thermal expansion of the deposited metal and the base metal are different. The chart shows that the coefficient of thermal expansion of Stellite No. 6 is very similar to that of the low alloy valve steels on which it is deposited. This, plus its "red" hardness and resistance to abrasion and corrosion at elevated temperatures makes it an excellent hard surfacing material for valves.

Edward



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Consultants — JACKSON & MORELAND, ENGINEERS of Boston, Mass.

AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY, where sound engineering principles are taught, two Wickes Steam Generators were selected to supply heat for several new buildings including the Hayden Library and Sloan Metals Research Laboratory. The Wickes Boilers, which were custom-engineered for M.I.T., produce 160,000 lbs., of steam per hour. They occupy the same space formerly occupied by the two old boilers that produced only 40,000 lbs. per hour. They are equipped with superheaters and economizers. The new boilers are oil-fired at present but are engineered for ready conversion to spreader stoker if desired. They are designed for quick steaming to meet emergency power requirements and are fitted with thermowells and openings for taking flue gas samples so the students at M.I.T. can run boiler tests as part of their instruction. The installation of these boilers, an extremely difficult job because of the close erection tolerances, was handled by Flagg, Brackett & Durgin, Inc., Wickes' agents in Boston. ✓ ✓ ✓ Wickes can fill your requirements for steam generators up to 250,000 lbs. per hour and 1000 psi.—all types of multiple drum boilers adaptable to any standard method of firing; oil, gas, underfeed or spreader stoker. Write today for descriptive literature or consult your nearest Wickes representative.

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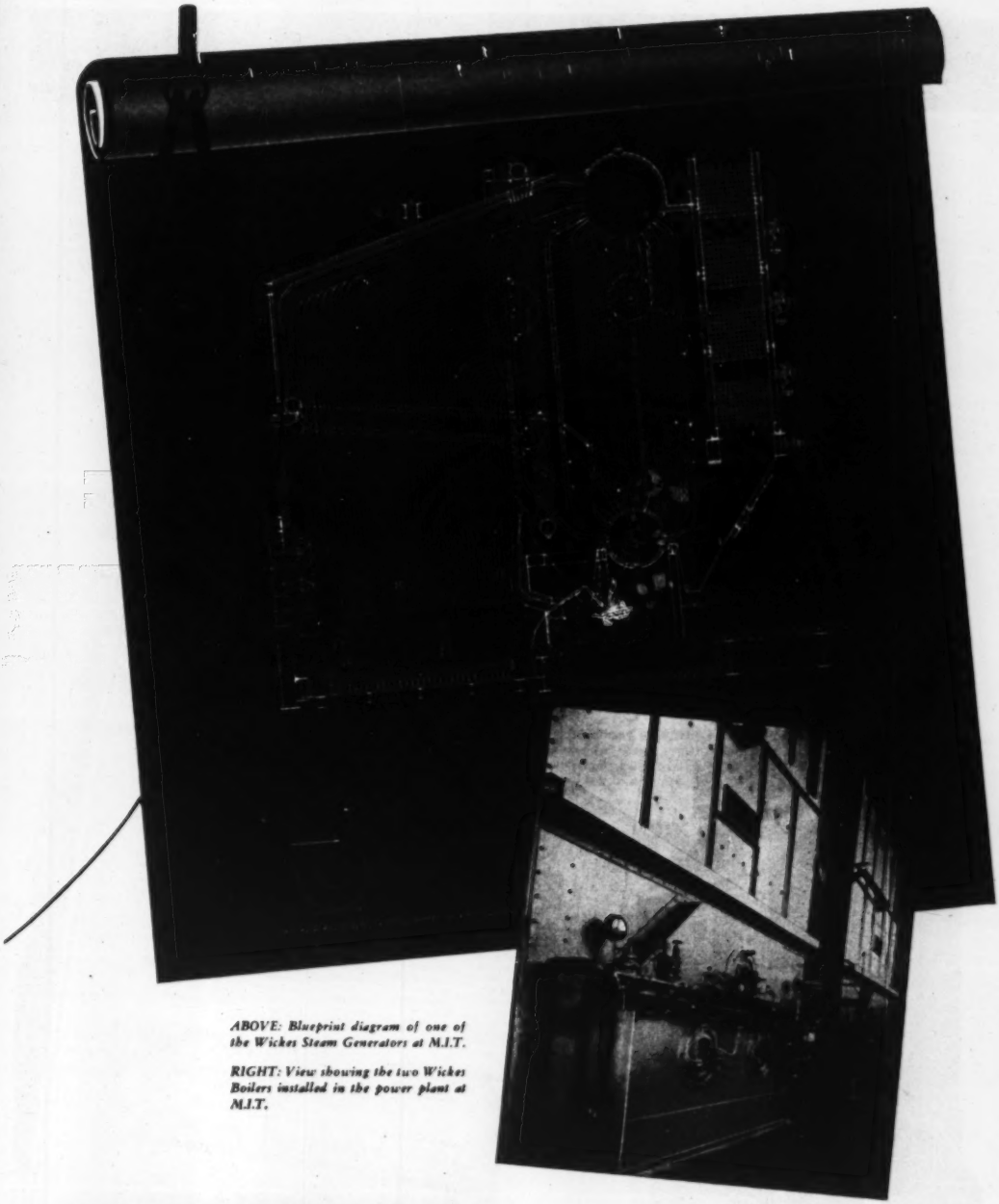

ABOVE: Blueprint diagram of one of the Wickes Steam Generators at M.I.T.

RIGHT: View showing the two Wickes Boilers installed in the power plant at M.I.T.

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THE WICKES BOILER CO.

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provide comfort heat in winter, summertime ventilation and fresh, outside air to replace foul air exhausted by ventilators over furnaces. At this modern plant, heat is delivered at the working level and kept there; the Dravo recirculation system keeps roof heat losses low. Heaters are automatic in operation; maintenance costs are low. Get this case study . . . and others on different problems . . . FREE!

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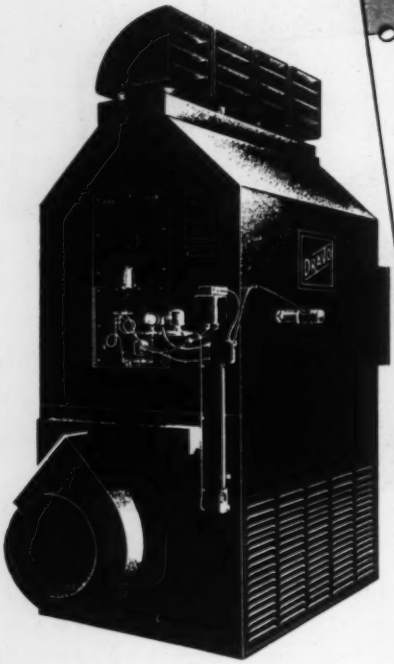
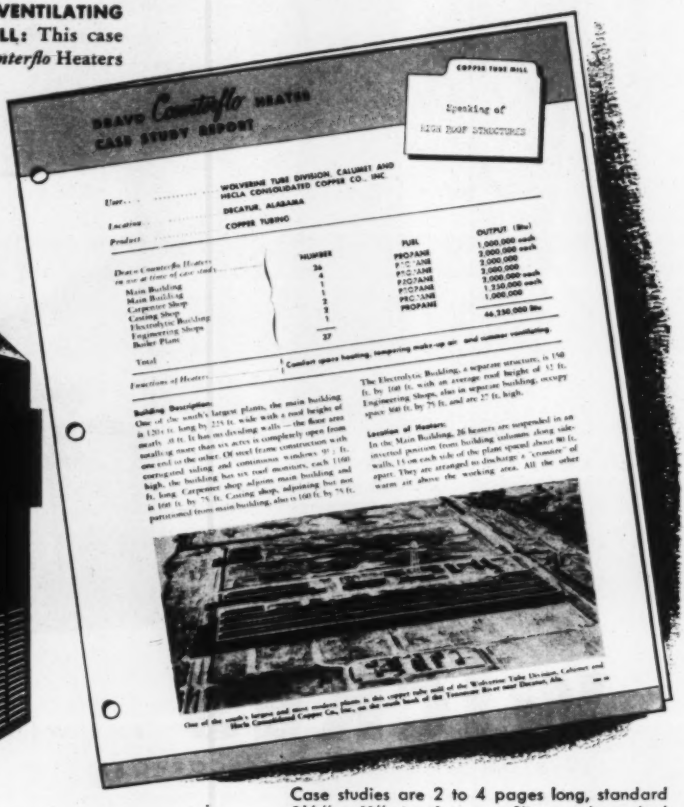
COMPLETE HEATING AND VENTILATING FOR A SIX-ACRE TUBE MILL: This case study tells how 37 Dravo *Counterflo* Heaters





DRAVO *Counterflo* HEATER
CASE STUDY REPORT

COPPER TUBE MILL

Speaking of
HIGH ROOF STRUCTURES

User... WOLVERINE TUBE DIVISION, CALUMET AND HECLA CONSOLIDATED COPPER CO., INC.
Location... DECATUR, ALABAMA
Product... COPPER TUBING

Dravo Counterflo Heaters on use at time of case study	NUMBER	FUEL	OUTPUT (Btu)
Main Building	26	PROPANE	1,000,000 each
Main Building	4	PROPANE	2,000,000 each
Carpenter Shop	1	PROPANE	2,000,000
Casing Shop	1	PROPANE	3,000,000
Electrolytic Building	2	PROPANE	2,000,000 each
Engineering Shops	2	PROPANE	1,250,000 each
Boiler Plant	1	PROPANE	1,000,000
Total	37	PROPANE	46,250,000 Btu

Functions of Heaters: Comfort space heating, tempering make-up air and summer ventilating

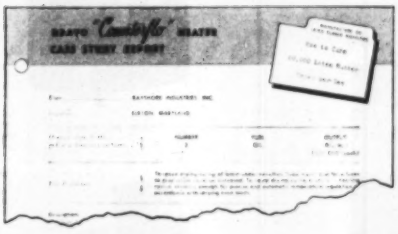
Building Description:
One of the south's largest plants, the main building is 120± ft. long by 775 ft. wide with a roof height of 30 ft. It has no dividing walls — the floor area totalling more than six acres is completely open from one end to the other. Of steel frame construction with corrugated siding and continuous windows 9' - 3" high, the building has six roof monitors, each 1160 ft. long. Carpenter shop adjoins main building and is 160 ft. by 75 ft. Casing shop, adjoining but not partitioned from main building, also is 160 ft. by 75 ft. The Electrolytic Building, a separate structure, is 160 ft. by 160 ft. with an average roof height of 37 ft. Engineering shops, also in separate building, occupy space 300 ft. by 75 ft. and are 27 ft. high.

Location of Heaters:
In the Main Building, 26 heaters are suspended in an inverted position from building columns along side walls, 14 on each side of the plant spaced about 80 ft. apart. They are arranged to discharge a "counter" of warm air above the working area. All the other

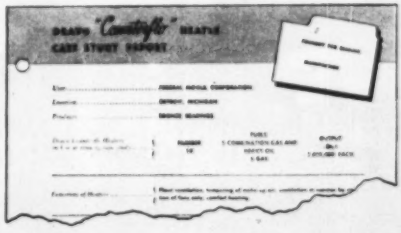
One of the south's largest and most modern plants is this copper tube mill of the Wolverine Tube Division, Calumet and Hecla Consolidated Copper Co., Inc., on the south bank of the Tennessee River near Decatur, Ala.

Case studies are 2 to 4 pages long, standard 8½" x 11" size for easy filing, and punched for 3-ring binder.

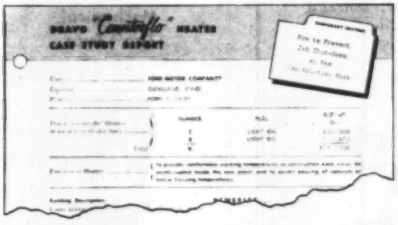
. . VERSATILE DRAVO *Counterflo* HEATERS



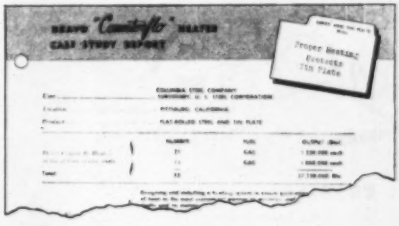
PROCESS DRYING AND HEAT CURING: In industrial production of products such as plastics, wood, rubber, paper, fibers, and ceramics, Dravo Heaters have often increased production due to faster, more efficient drying and curing.



TEMPERING OF MAKE-UP AIR: Where the necessary removal of noxious fumes or harmful dusts from the air makes comfort heating for workers difficult, Dravo Heaters warm replacement air and keep temperatures constant.



TEMPORARY HEATING: Dravo Heaters provide comfort heating and increase worker-efficiency during building construction and can keep ground temperature above freezing for pouring and setting concrete floors during cold weather.



COMFORT HEATING LARGE BUILDING AREAS: Garages, diesel repair shops, auditoriums, etc. with large open spaces are heated comfortably and easily . . . Dravo Heaters provide quick, automatically controlled, low-cost heat.

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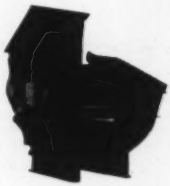

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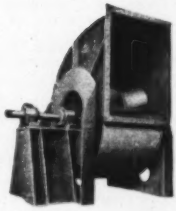

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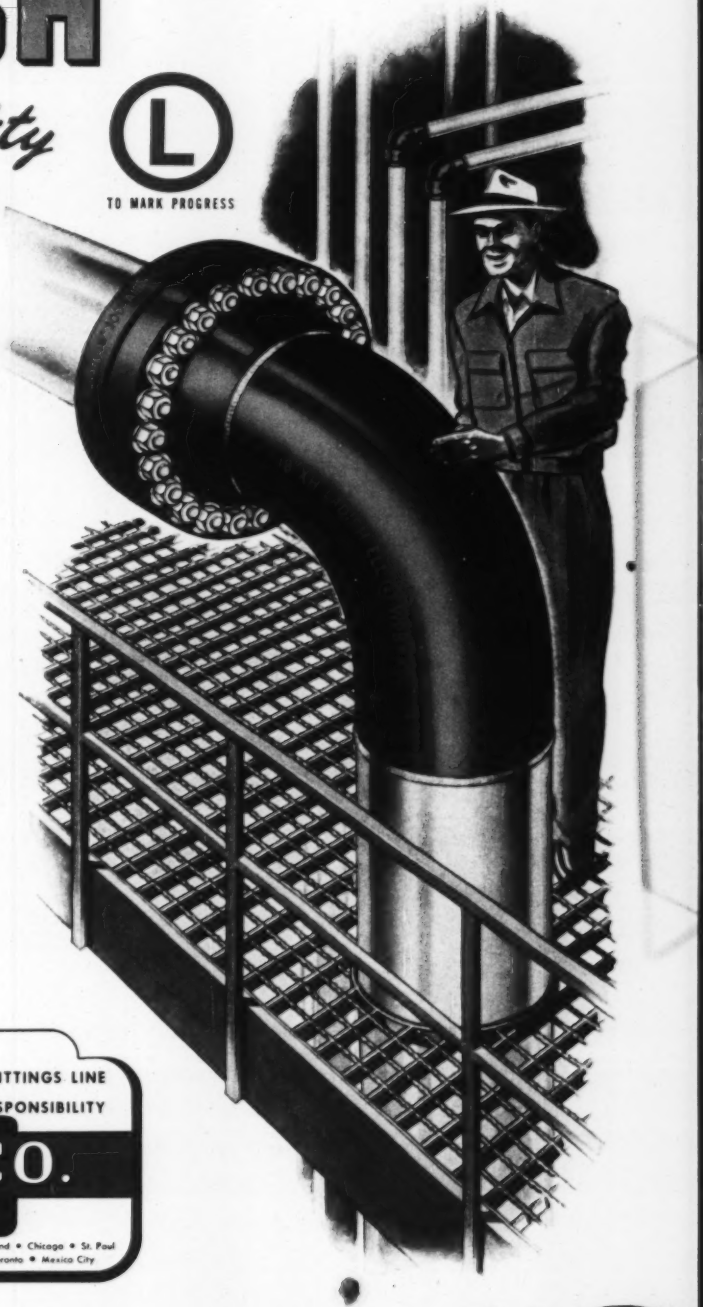

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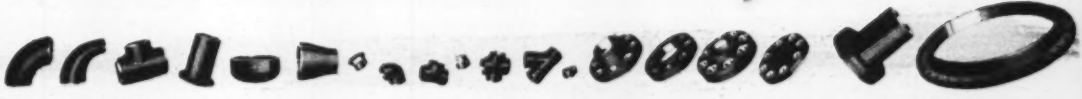

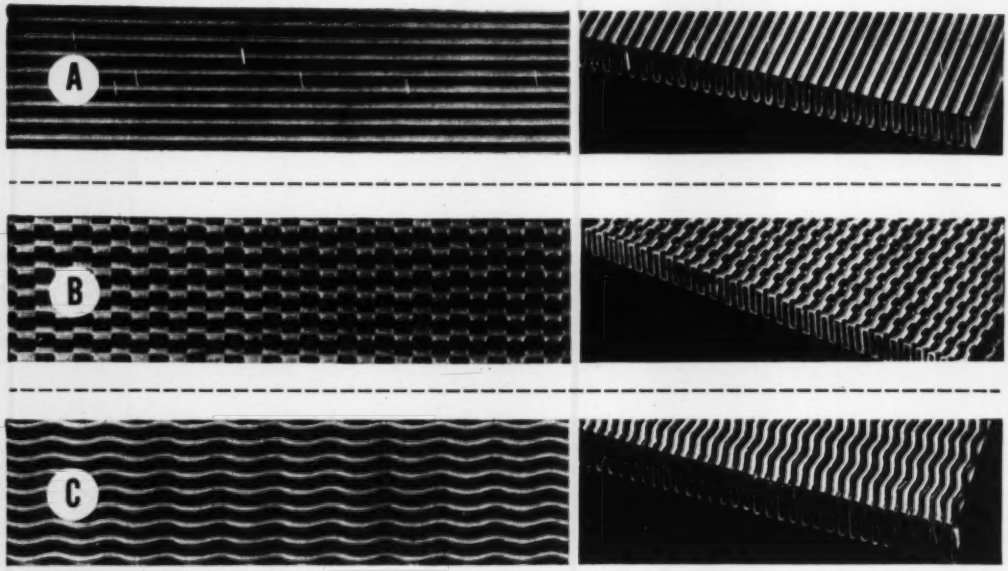

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TRANE Brazed Aluminum Heat Exchangers Offer Wide Choice of Heat Transfer Surfaces for Greater Design Flexibility

With Trane Brazed Aluminum Heat Exchangers, you choose from a great variety of surfaces in solving exactly your heat transfer problems. They may be straight and continuous (A). They may be serrated (B). Or they can be of herringbone design (C). With these basic designs, exactly the right surface can be selected to provide the correct ratio of heat transfer to pressure drop characteristics.

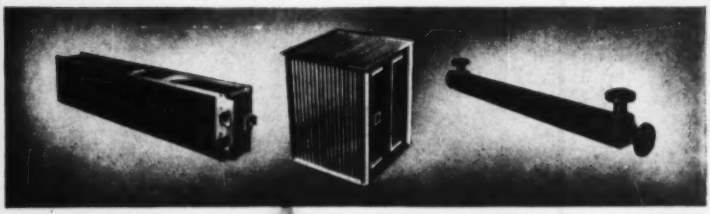
Many further variations of these general types are practical. The height and the thickness of the fin can be varied. So can the number of fins per inch. In fact, fins with entirely different patterns, heights and number of corrugations per inch can be used side-by-side to handle different fluids in the same exchanger.

Thanks to this great flexibility you can provide just the heat transfer, just the pressure drop volume, velocity number and direction of passes you want with Trane Brazed Aluminum Heat Exchangers.

Design flexibility is but one of the many advantages of Trane Brazed Aluminum Heat Exchangers. Compared to conventional exchangers, they produce more heat transfer efficiency in $\frac{1}{4}$ the space with $\frac{1}{3}$ the weight at approximately $\frac{1}{2}$ the cost.

These all-aluminum heat exchangers are rugged, too. They take test pressures up to 1,000 pounds per square inch and temperatures from −300° to 500° F.

Whether the job calls for high or low temperatures or pressures, one stream or many, Trane Brazed Aluminum Heat Exchangers can be the answer. Contact your Trane sales office or write direct.



Here are a few of the many varieties of Trane Brazed Aluminum Heat Exchangers which are now in actual service: 1) A cross flow unit for liquid-to-gas exchange used for condensing purposes. 2) A cross flow gas-to-gas unit which is used for intercooling for aircraft engines. 3) A counter flow liquid-to-liquid exchanger for high pressure application.

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So Taylor Forge went to work on this and after long research and development came out with the full line that became the inspiration of modern pipe welding.

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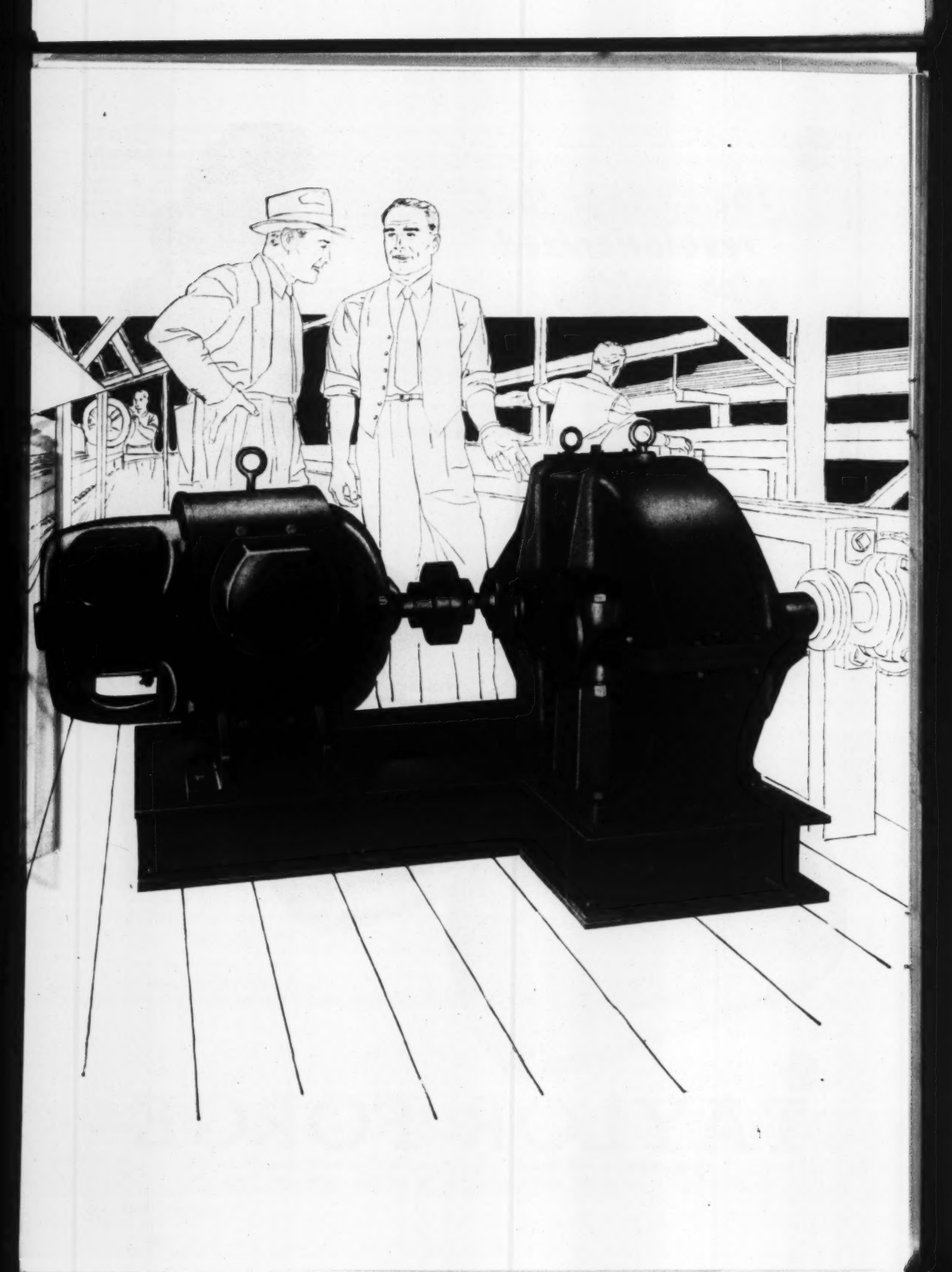


"I'll tell you why we buy these Westinghouse Drive Teams"

"We obtain exclusive benefits from the planning stage right on through the long life of the drive. You see, experienced Westinghouse Application Engineers know both mechanical and electrical drive problems. When we put our heads together, we always come up with a better drive solution.

"We also benefit every step of the way from ordering to maintenance because there's only one point of contact required—undivided responsibility. Westinghouse ability and willingness to handle our complete drive requirements sure saves us plenty of headaches. Saves our time and dollars, too.

"Experience has shown us that we can depend on a Westinghouse Speed Reducer. The taper-hardened, accurately hobbed gears, the rugged tight case, the efficient roller bearings, the positive lubrication system—all add up to a speed reducer that is second to none.

"The Life-Line d-c motor deserves its share of the credit, too. The features we especially like are the pre-lubricated bearings and the all-steel construction. We install a Life-Line motor and forget it."

The next time you have a drive problem, call in your Westinghouse representative. Remember—Westinghouse makes the complete drive.

Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

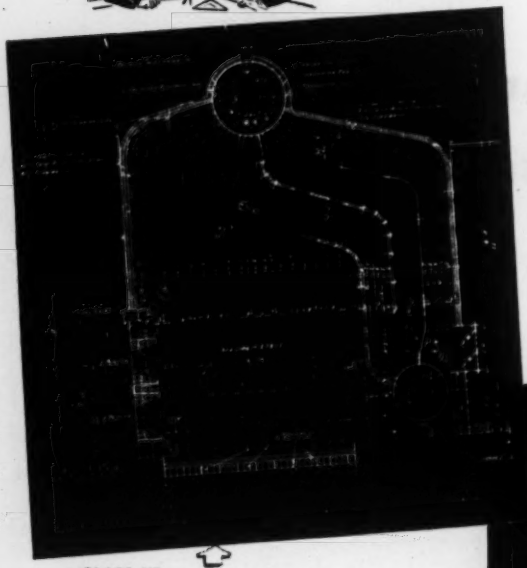
J-07307

Industry Approved

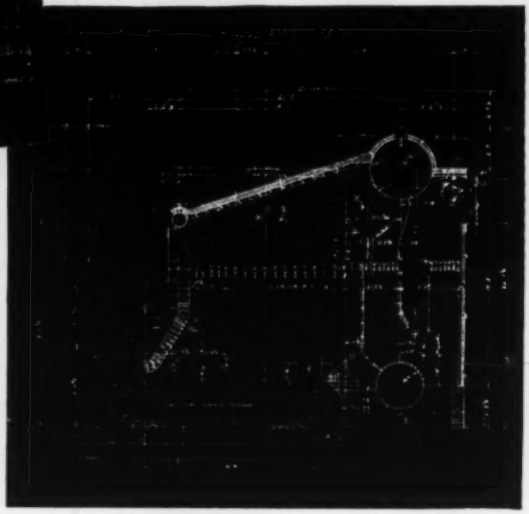
Two-Drum

STEAM GENERATORS

by Vogt



CLASS VF
A 22,000 pounds steam per hour unit installed at Indiana Farm Bureau Refinery, Mt. Vernon, Ind.



CLASS VS
The Seelbach Hotel, Louisville, Ky. is served by this 30,000 pounds steam per hour boiler.

A wide variety of industrial plants and other users of steam for power, processing, or heating have found these efficient Vogt Two-Drum Type Boilers to be the answer to their diverse steam generating requirements.

Class VF units provide maximum capacity in limited floor space and head room, while Class VS is best adapted to installations not having such restrictions. Each has a large furnace volume and a high ratio of radiant heating surface. The furnace design assures proper combustion of fuels fired in suspension or with various type of stokers.

A bulletin with general information and showing typical installations is available on request.

Typical Users...

FOOD PROCESSING PLANTS

DISTILLERIES • HOTELS

HOSPITALS • CHEMICAL PLANTS

PETROLEUM REFINERIES

HENRY VOGT MACHINE CO., Louisville 10, Kentucky

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

We Haven't Made Them This Big... *YET,*

but this photographic fantasy is simply to remind you that we do manufacture the most varied line of welding elbows on the market.

MIDWEST
PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices: New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—436 First St.
STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

MIDWEST "LONG TANGENT"

Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 24".

ASA STANDARD

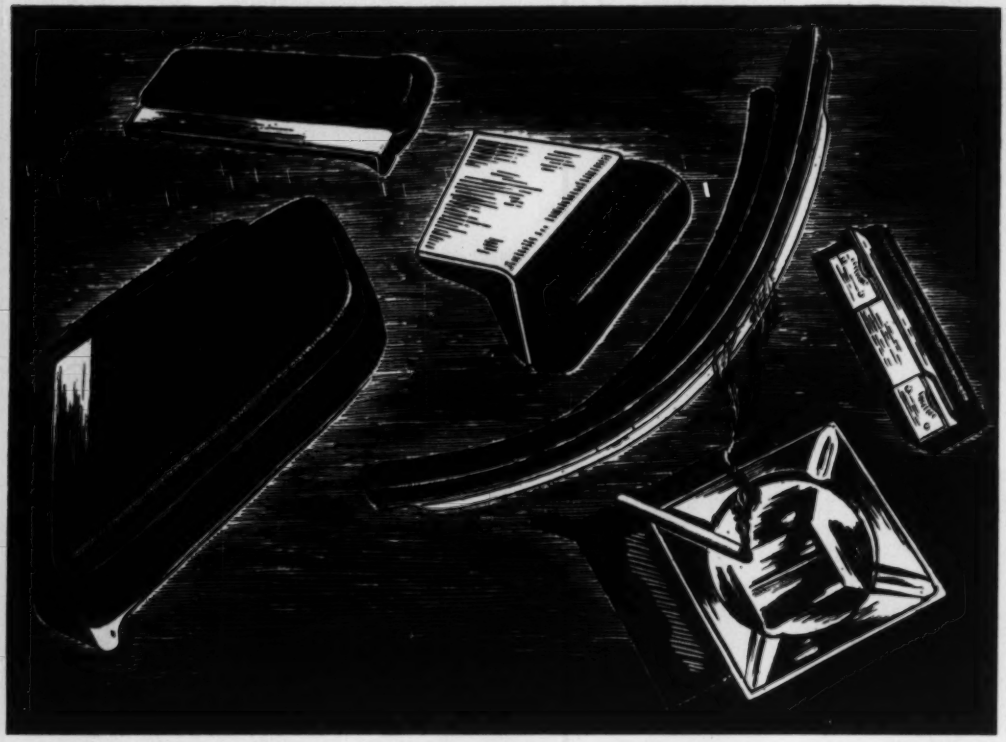
Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings, ASA B16.9. Tolerances much less than allowable. Sizes to 26".

SHORT RADIUS

Recommended where space limitations do not permit use of "Long Tangent" or ASA Elbows. Sizes to 30".

MIDWEST REDUCING

Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 12", reductions to half size.



CELLULAR RUBBER BONDED TO METAL

one more example of the versatility of SPONGEX

Each of these parts was made by bonding Spongex cellular rubber to metal. Yet in each, Spongex had to meet different specifications. In one, Spongex must remain flexible even at −65° F. In another, it must be heat resistant and fire retardant. A third must have low water absorption. *All* possess one important quality . . . the superior bonding characteristics of Spongex for unexcelled adhesion of rubber to metal.

Bonding of Spongex to metal might not be your need. But if your need is cellular rubber, we've got it . . . in strips, rolls, cording, tubing and die-cut shapes. Learn more about how Spongex can help you . . . write for "Properties of, and Test Data on, Cellular Rubber."

SPONGEX® Cellular Rubber

used for cushioning, insulating, shock absorption, sound and vibration damping, gasketing, sealing, weatherstripping and dust proofing.

THE SPONGE RUBBER PRODUCTS COMPANY 501 Derby Place, Shelton, Conn.

How you can check
PRECISION GEARS

- *quickly . . .*
- *conclusively . . .*
- *to closest tolerances*

with the

KODAK CONJU-GAGE GEAR CHECKER

To gear manufacturers and engineers faced with the problem of quantity production of tight-tolerance gears, a Kodak Conju-Gage Gear Checker provides the ideal solution.

It's fast—the production gear is quickly mounted and revolved against a Kodak Conju-Gage Worm Section. The composite effect of runout, base pitch and profile error, tooth thickness variations, and lateral runout is recorded automatically for ready, permanent reference. And a single Worm Section can be used for all spur or helical gears of any helix angle or any diameter, as long as they have the same normal pitch and pressure angle.

It's conclusive—Kodak Conju-Gage Gear Checkers conform to the composite gear-check principle recommended in the new American Standard, "Inspection of Fine Pitch Gears." It eliminates arguments or questionable rejection losses.

It's accurate—the inherent accuracy of the Kodak Conju-Gage Worm Section permits an exceptional order of precision, even in finer pitches. Specifications limiting tooth-to-tooth composite error to .0002" are easily met. Your own toolroom procedures can keep check on the accuracy of the gaging master. And, unlike circular masters, it can be reground to original specifications and precision, if necessary.

Kodak Conju-Gage Gear Checker, Model 8U, tests gears up to 8½ inches in pitch diameter. Smaller models check gears up to 1¼ and 4⅛ inches, respectively.

To find out more, send for your copy of the booklet, "Kodak Conju-Gage Gear Testing Principle." It's free, without obligation. Write to Eastman Kodak Company, Industrial Optical Sales Division, Rochester 4, N. Y.

CONJU-GAGE INSTRUMENTATION

. . . a new way to check gear precision in action

To inspect all kinds of complex parts on a bright screen, Kodak also makes two highly versatile contour projectors.

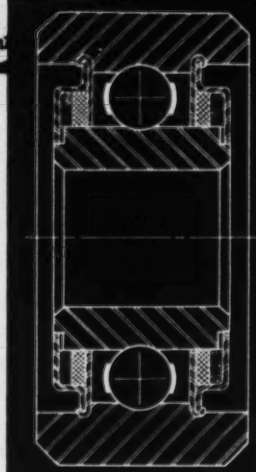
Kodak

Specialists IN "Specials"

"Specials" are ball bearings which have been custom designed to be "exactly right" for a particular application. Thus, the field for specials ranges from modification of existing standard bearings to complete new bearings of unusual shapes and dimensions. As "specialists in specials," experienced NICE engineers take advantage of every design opportunity to reduce costs without sacrifice of quality and to improve product performance and appearance.

SPECIAL BEARINGS

of unusual shapes and dimensions



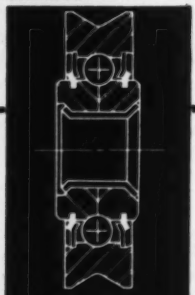
NO. 6866 CAM FOLLOWER

Representative of Nice ingenuity is No. 6866, a cam follower on an agricultural harvester. No. 6866 replaces a precision bearing pressed into a specially machined outer tire . . . and the resulting improvements were:

1. **LOWER COST (OVER 30% SAVINGS).**
2. **INCREASED CAPACITY.**
3. **MORE EFFECTIVE SEAL.**
4. **PACKAGED INTERCHANGEABLE UNIT.**
5. **IMPROVED APPEARANCE AND PERFORMANCE.**

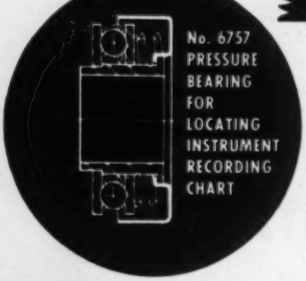
Characteristic of agricultural machinery, severe dust and dirt problems dictated the need of an efficient and rugged seal. No. 6866 seal has proved to be highly effective and durable.

Where new tooling is justified by the quantities involved, specials of this type, where applicable, offer the greatest possibilities for cost savings and product improvement. A few typical application examples are illustrated.



No. 6750 BALING MACHINE WIRE GUIDE

SEMI-PRECISION "SPECIALS"



No. 6757 PRESSURE BEARING FOR LOCATING INSTRUMENT RECORDING CHART

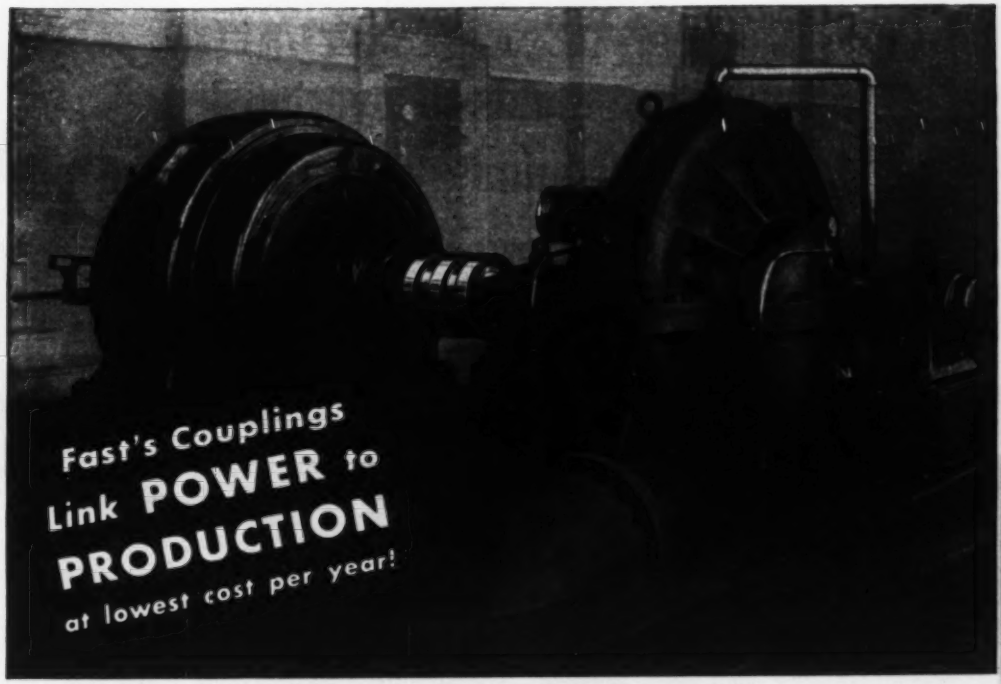
Many precision bearing applications do not require all of the elements of precision that are normally incorporated in a standard precision unit. For example, if the bearing cone is locked against a step on the shaft, grinding of the bore can be eliminated and will save approximately 10% of the selling price of a 2" OD precision annular bearing. Similarly, if the loads are not severe nor the RPM excessive, polishing of the ball grooves may not be necessary and will reduce the cost about 10%. In a light load application, the outer ring material can be changed to a less expensive steel at a savings of as much as 8% of the selling price.

THE USE OF SEMI-PRECISION BEARINGS, WHERE INDICATED, MAY REFLECT SUBSTANTIAL SAVINGS TO THE MANUFACTURER WHO BUYS BEARINGS IN PRODUCTION QUANTITIES.

NICE

NICE BALL BEARING COMPANY

NICETOWN · PHILADELPHIA · PENNSYLVANIA



FAST'S Couplings usually outlast the equipment they connect!

ACTUAL cases on record show many Fast's Couplings are still in service after as much as 30 years of continuous operation! Time and time again, equipment has been replaced while the original Fast's Coupling remained on the job.

To you, these records of dependable, trouble-free service mean freedom from costly coupling failures when you specify Fast's. And they mean Fast's cost you far less to own and operate . . . because their cost can be amortized over long years of dependable performance.

For full details on how Fast's Couplings and Koppers Engineering Service can help you, write today for a free copy of our catalog to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 259 Scott St., Baltimore 3, Maryland.

Here's How FAST'S Save You Money

Free Service—Koppers free engineering service assures you the right coupling for the job.

Rugged Construction—Fast's still maintains its original design, without basic change or sacrifice in size or materials. Result: freedom from expensive coupling failures.

Lowest Cost per Year—Fast's Couplings usually outlast equipment they connect. Their cost may be spread over many years!

KOPPERS

FAST'S
THE ORIGINAL
GEAR-TYPE
Couplings

INDUSTRY'S STANDARD FOR 32 YEARS

KOPPERS COMPANY, INC., *Fast's Coupling Dept.*,
259 Scott St., Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

Name .....

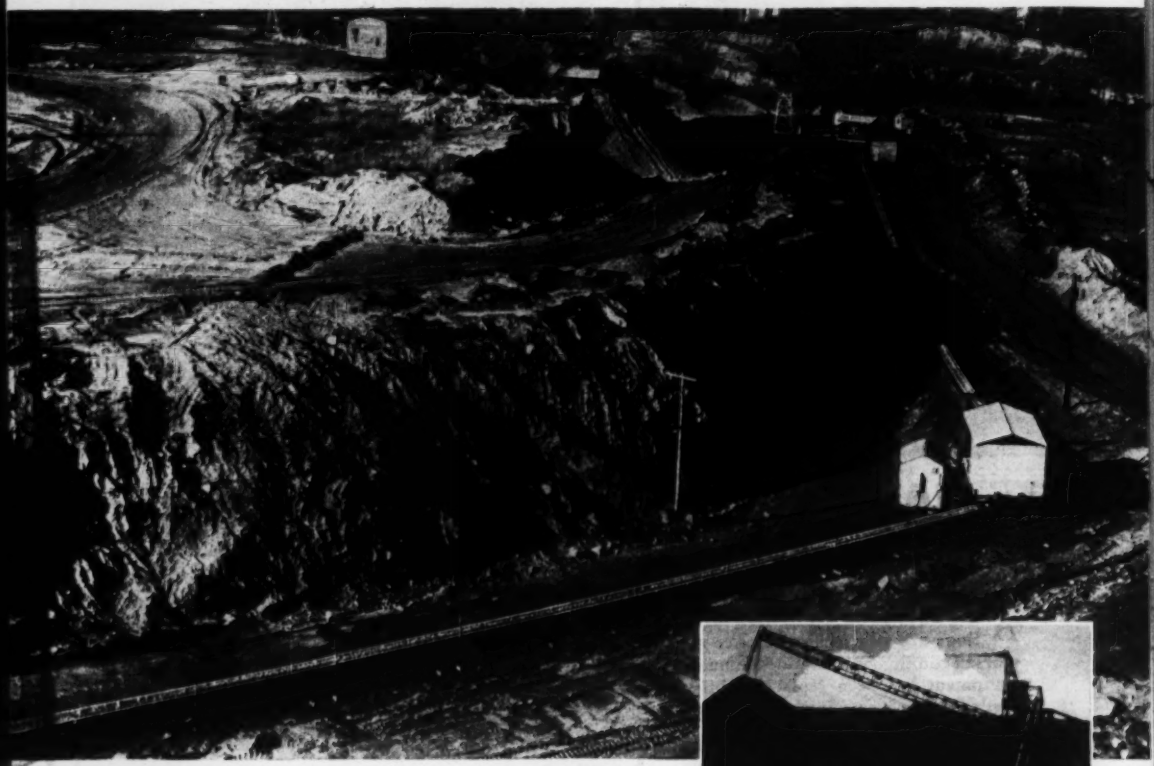
Company .....

Address .....

City ..... *Zone* ..... *State* .....

LINK-BELT research and engineering . . . Working for Industry

50 million pounds of overburden a day take this 10-minute ride out of the pit



At another pit, Link-Belt self-propelled stacking belt conveyor stockpiles iron ore at 600 long tons per hour. Its 115 ft. radius and 570 ft. travel provide huge storage facilities.

12,873

LINK-BELT conveyor systems prove most efficient means of transportation in modern metal mining

FROM the pits of the Mesabi Iron Range, Link-Belt conveyor systems — up to several miles long — carry out, first the overburden, then the rich, red ore.

Because they rise directly from the mine-bottom, up steep inclines, they save miles of costly right-of-way around the edges of the pit that would be needed for other means of transportation. Efficient, 'round-the-clock movement of materials . . . with no loss of time for empty return trips . . . assures high-capacity, low-cost handling.

In the production of almost every metal, Link-Belt conveying and preparation plant equipment is utilized. And you'll find widespread evidence of Link-Belt research and engineering in the processing of all of America's natural resources. From farms and forests to mills and factories, Link-Belt materials handling and power transmission products touch almost everything we eat, wear and use in daily living.

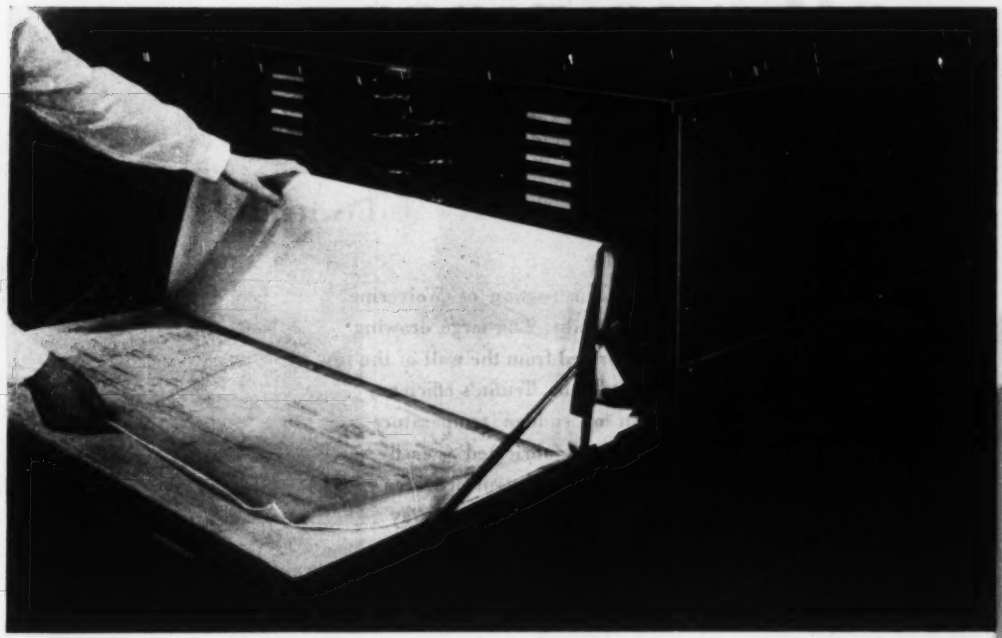
LINK-BELT

LINK-BELT COMPANY

Executive Offices:
307 N. Michigan Ave., Chicago 1, Ill.
Plants: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa), Sydney (Australia). Offices in Principal Cities.

ONE SOURCE . . . ONE RESPONSIBILITY FOR MATERIALS HANDLING AND POWER TRANSMISSION MACHINERY

Are you using this *Safe Simple Speedy* filing equipment?



This is a Hamilton Shallow-Drawer Unit, which gives you greater drawing-protection and speedier, easier access than any filing equipment you can buy.

The exclusive Hamilton Tracing Lifter shown in action above is the major reason. Here's what this does for you—

first, it *RAISES* and *HOLDS* sheets filed above the one you want

second, it *LIFTS* and *SUPPORTS* these sheets while you safely remove or replace a drawing

third, it *COMPRESSES* all sheets when drawer is closed—keeps them perfectly flat and wrinkle-free

Can you improve your filing system with this *safe, simple, speedy* equipment? Yes . . . and at a surprisingly modest cost. Ask your Hamilton Representative to prove this, or write Hamilton now for complete specifications.

Want more details on Hamilton Shallow-Drawer Units? Write today to Drafting Equipment Division, Hamilton Manufacturing Company, Two Rivers, Wisconsin.

HAMILTON WORK-DESIGNED DRAFTING EQUIPMENT

Hamilton Manufacturing Company

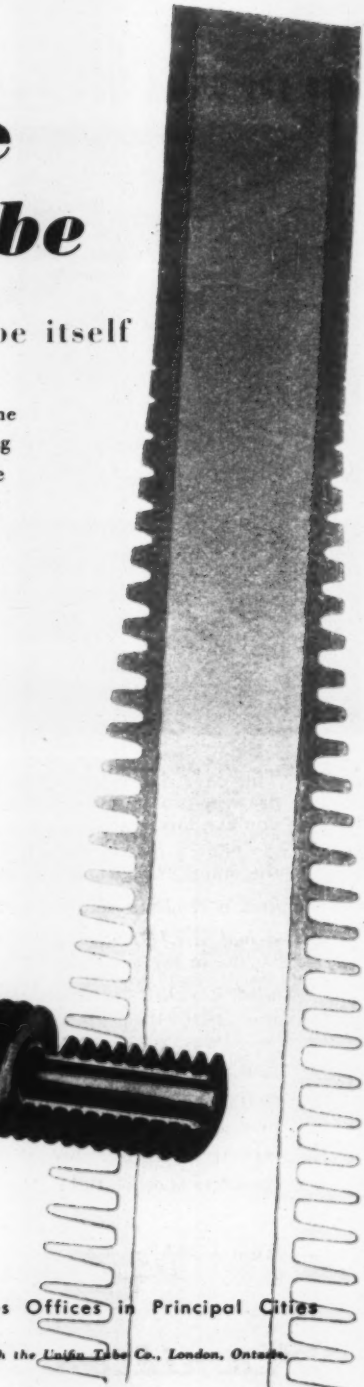
TWO RIVERS, WISCONSIN

all one piece ...*finned tube*

The fins are extruded from the tube itself

These two views show the construction of Wolverine Trufin* — the integral finned tube. The large drawing illustrates how the fins are formed from the wall of the tube and remain a part of it. Thus, Trufin's efficiency is unaffected by vibration or sudden temperature changes. This finned tube can be fabricated as easily as plain tube. Trufin has an outside surface area many times that of plain tube and points the way to greatly increased efficiency. In addition Trufin can often help you reduce unit size, installation and maintenance time, thus lowering your costs. Find out about Trufin, the integral finned tube, and its relation to your own heat transfer application. Available in a variety of sizes, fin spacings and alloys. Send for your copy of the new brochure, Wolverine Fabricated Parts.

*Reg. U.S. Pat. Off.



WOLVERINE TUBE DIVISION

Calumet and Hecla Consolidated Copper Company
Incorporated

Manufacturers of tubing exclusively

1437 CENTRAL AVENUE • DETROIT 9, MICHIGAN

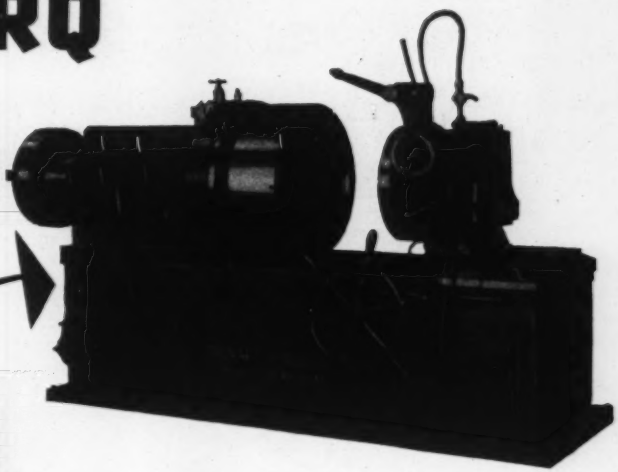
Plants in Detroit, Michigan and Decatur, Alabama; Sales Offices in Principal Cities

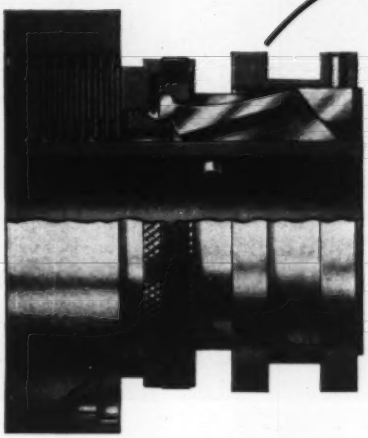
Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

Export Department, 13 E. 40th St., New York City 16, N. Y.

MAXITORQ

KEEPS GOOD COMPANY





The Maxitorq floating disc Clutch was selected as standard equipment in 1949 for the 4 sizes of the Pipe Threading and Cutting machines manufactured by the Bignall & Keeler Division of John Ramming Machine Co., St. Louis.

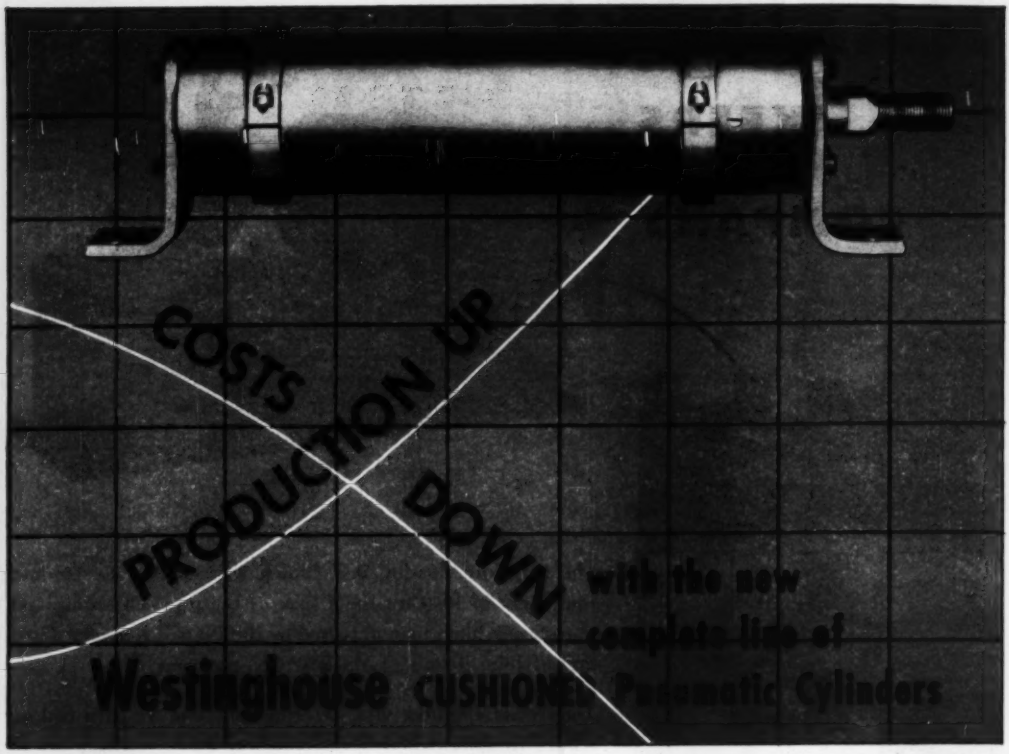
Their chief engineer says, "During this time we have had no service trouble involving the clutch or drive. Accessibility of the clutch and simplicity of its adjustment have contributed to a most successful design."

Maxitorq engineers are always pleased to see an application such as this, where it is possible to adjust or replace the clutch without tearing down the machine. One of our design objectives is to get more machine builders to adopt this policy. Maxitorq, however, gives top performance wherever it is installed.

If you require smooth, reliable power transmission within the Maxitorq range (8 sizes from fractional to 15 H.P. at 100 r.p.m.) single or double, wet or dry . . . ask our engineers for recommendations. Design is compact, streamlined . . . completely assembled on body and shipped ready to slip onto a shaft. Separator Springs prevent drag, abrasion, and heating in neutral . . . all assembly, adjustment and take-apart are manual operations.

SEND FOR CATALOG NO. ME9.

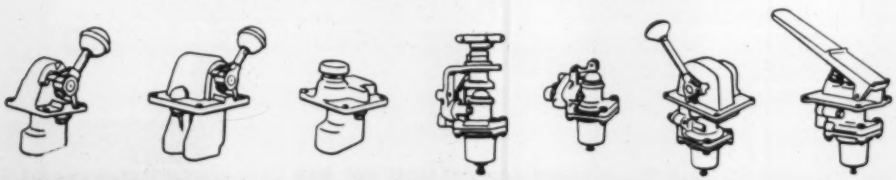
THE CARLYLE JOHNSON MACHINE COMPANY
MANCHESTER • CONNECTICUT



8 NEW PRODUCTION BOOSTERS

1. Diameters: 1½" to 8" . . . any required stroke
2. Cushioned adjustable stroke
3. Flange, foot, swivel, or trunnion mounting
4. Pressure type end seals against leakage
5. Rotating heads for easy installation
6. Solid construction
7. Stock heads, rods and barrels assemble to meet requirements
8. Packing cups of famous "WABCO" ® composition

. . . and a complete range of modern pneumatic controls



INDUSTRIAL PRODUCTS DIVISION

WESTINGHOUSE AIR BRAKE COMPANY
WILMERDING, PENNA.

Factory Branch: Emeryville, Calif. Distributors Throughout the United States . . . Consult Your Classified Directory. *Distributed in Canada by:* Canadian Westinghouse Co., Ltd., Hamilton, Ontario

SK News

Rotameters Offer Definite Advantages In Metering Fluid Rate of Flow

(On-The-Job Photos by Courtesy of Hoffmann-LaRoche, Inc., Nutley, N. J., Manufacturers of Pharmaceutical Chemicals and Vitamins)

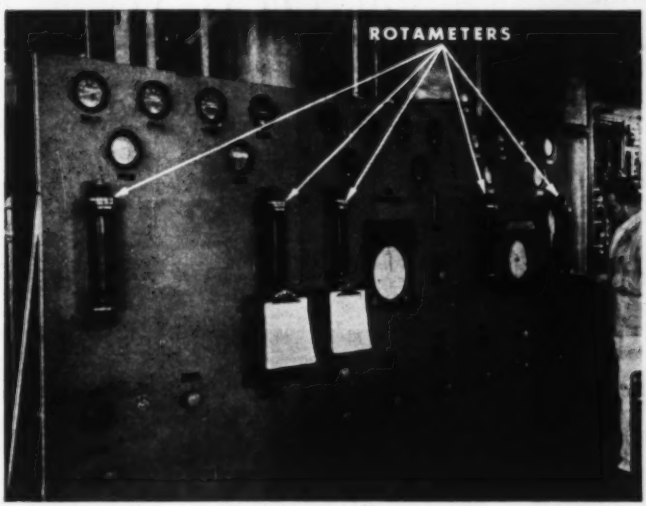
In the modern plant of Hoffmann-LaRoche, Inc., in Nutley, N. J., SK Universal Rotameters are used in large numbers to measure fluid flow rates in the manufacture of pharmaceutical chemicals and vitamins.

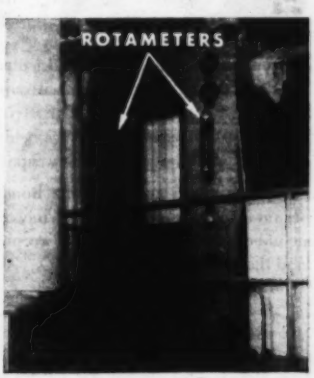
In metering rate of flow, Rotameters offer definite advantages. They are fast and accurate—are easy to read. Since they have only one moving part, the rotor, maintenance is very simple. Cleaning is easy and fast since the Rotameter can be dis-assembled without disturbing pipe connections. They are versatile in that they can be designed to meet varying requirements.

The SK Universal Rotameter is suitable for most applications, however, many other types are available. These other types include: Chemical, Armored, Flow Alarm, Electronic Recording, Pneumatic Recording, Laboratory, Bypass, and other Rotameters. Each type offers definite construction and operation features of value to anyone desiring to measure fluid rate of flow.

All types are based upon the same basic principles of operation. Fluid enters the tapered meter tube at the bottom and leaves at the top. The fluid exerts a force on the rotor which is proportional to the rate of flow and holds the rotor in a steady position in the tube for any rate of flow within the range of the meter. The rotor position in regard to the scale on the meter tube indicates the rate of flow.

Bulletin 18-RA pictures and briefly describes all types of SK Rotameters and lists, by number, the detailed bulletin relating to each. Request a copy.





The SK ENGINEERING NEWS, published quarterly in magazine form, contains articles on principles and applications of equipment manufactured by Schutte and Koerting Company. We will gladly add your name to the NEWS' mailing list.

"USE MARCHING FIRE—and *follow me!*" Shouting this command, Lieutenant Carl Dodd struck out in advance of his platoon to lead the assault on Hill 256, near Subuk, Korea. During the fierce in-fighting that followed, he constantly inspired his men by his personal disregard of death. Once, alone, he wiped out a machine gun nest; another time, a mortar. After two furious days, Dodd's outnumbered, but spirited, force had won the vital hill.

"You were helping, too," says Lieutenant Dodd. "You and the millions of other citizens who have bought U. S. Defense Bonds. For your Bonds, *which keep America strong*, were behind the productive power that gave us the weapons we used.

"I hope you'll go on buying Bonds—always. Because your Bonds—and our bayonets—make an unbeatable combination for keeping safe the land that we all love!"

* * *

Now E Bonds earn more! 1) All Series E Bonds bought after May 1, 1952 average 3% interest, compounded semiannually! Interest now starts after 6 months and is higher in the early years. 2) *All maturing E Bonds* automatically go on earning *after maturity*—and at the new higher interest! Today, start investing in better-paying United States Series E Defense Bonds through the Payroll Savings Plan where you work!

First Lieutenant
Carl H. Dodd
Medal of Honor

Peace is for the strong! For peace and prosperity save with U.S. Defense Bonds!

The U.S. Government does not pay for this advertisement. It is donated by this publication in cooperation with the Advertising Council and the Magazine Publishers of America.

It's here! New Bruning **Copyflex 14**

speeds Production Control, Work Tickets, Accounting, Purchasing, Shipping, All Factory Paperwork!

Bruning announces its COPYFLEX 14—the revolutionary new management tool for increasing efficiency throughout factory and office.

Especially designed for desk-side copying of any system, accounting or office form, the "14" gives you error-proof, smudge-proof, low cost copies *in seconds*.

It is the newest of Bruning's renowned COPYFLEX machines—standard white-print equipment for engineering departments everywhere.

Typical COPYFLEX users* reap savings!

1. COPYFLEX *saves* life insurance company $100,000 yearly via loan processing system.
2. COPYFLEX *enables* apparel manufacturer to lower product price with production control, order-invoice system.
3. COPYFLEX *speeds* manufacturing, saves hundreds of man-hours, for large metal fabricator via production control system.
4. COPYFLEX *saves* national merchandiser $25,000 in six months by cutting clerical work in half, producing invoices on time.

*Names on request.

ONLY COPYFLEX 14—*of all desk-side copying machines—gives you . . .*

1. 20" width! Copies even *large* reports, or two ordinary forms simultaneously. Separates and returns originals automatically.

2. No installation! No fumes, so no exhaust ducts are needed. Thus, the "14" is *mobile*, rolls to any work-site.

3. Copies even opaque originals or forms printed on *both* sides, using Bruning's exclusive Reflex Film!

4. Unequalled combination of speed, volume, low-cost. Copies thousands of large or small, *different* originals daily, at an average cost of only 2¢ per sq. ft.

COPYFLEX 14 makes exact copies . . . delivered in seconds—flat, dry, ready-to-use. There are no masters or stencils, no inks to soil hands, no darkroom, no fumes, no special room lighting, no high-priced operators. Anyone can learn to make copies in 5 minutes.

There's a COPYFLEX machine for every price or print requirement. See how Bruning COPYFLEX can speed your paperwork, give you *better* prints *faster*. Just send in the coupon to the Charles Bruning Co., Inc., Teterboro, N. J.

COPYFLEX 93 handles cut sheets or roll stock up to 42 in. wide.

BRUNING

Specialists in copying since 1897

Mail Now for full, money-saving COPYFLEX story!

CHARLES BRUNING COMPANY, INC.
Dept. H92, Teterboro, N. J.

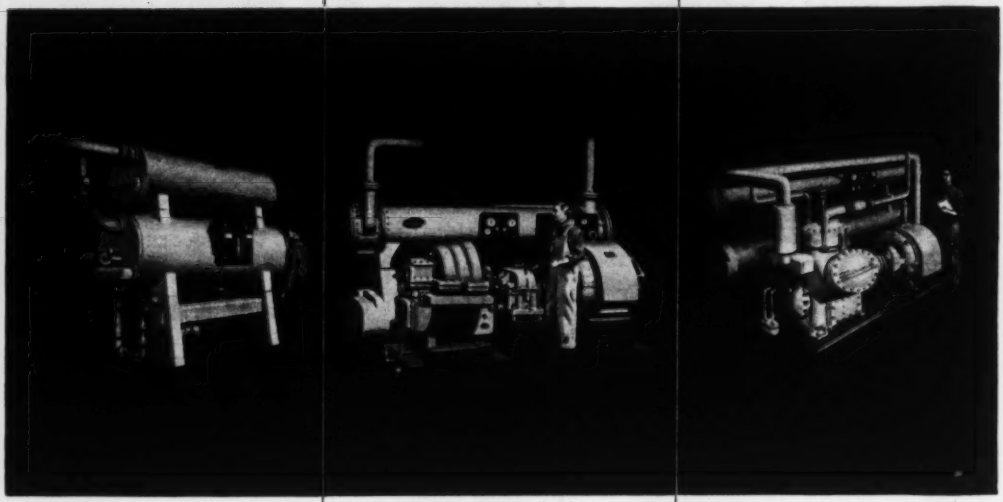
☐ Send me free booklet on COPYFLEX 14.
☐ Show me COPYFLEX in action (no obligation).

Name..... Title.....
Company.....
Street.....
City..... State.....

OFFICES IN PRINCIPAL CITIES

Why three ways to make "cold"?

Because there's more to making cold than just pulling temperatures down. Because hardly any two jobs are alike. Because such things as your power supply, the structure of your building, the job you want the cold to do for you, all make a difference when you choose a refrigerating machine. That's why Carrier gives you your choice of *three*. *One* of them is best for your refrigerating or air conditioning job.



The Carrier Absorption Refrigerating Machine makes cold from heat. Uses high-pressure steam or low-pressure steam or waste steam from plant equipment. Lightweight, compact, practically vibrationless—it goes onto roofs or intermediate floors without heavy foundations. Adapts automatically from full loads down to 10% of capacity without loss of efficiency. No highly skilled operator needed. Five sizes, 115 to 350 tons. Adaptable for multi-unit installation. For many applications, it's the most economical installation you can make.

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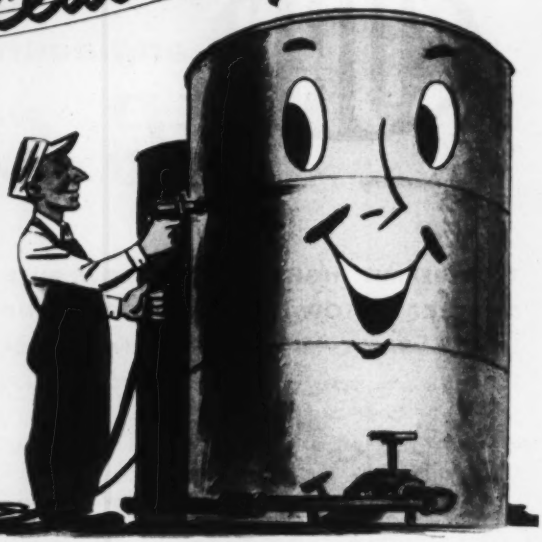

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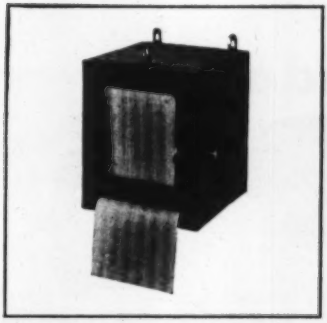

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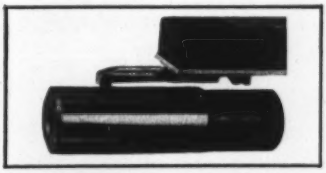

CHARTS SURFACE PROFILE. As this Brush Pickup probes the surface on the cylindrical piece, a chart is drawn by a Brush Surface Analyzer . . . giving positive, numerical recording of the surface profile. Surface irregularities of less than 1 micro-inch can be measured accurately. Brush Surface Analyzers eliminate guesswork in specifying and checking finishes on various surfaces: metal, plastic, glass, paper, etc. In addition to chart recording, *average finish* is indicated on a large illuminated scale.

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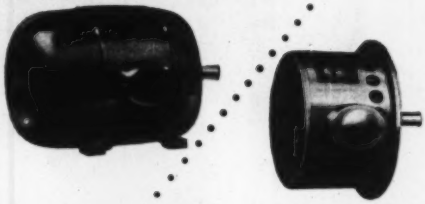

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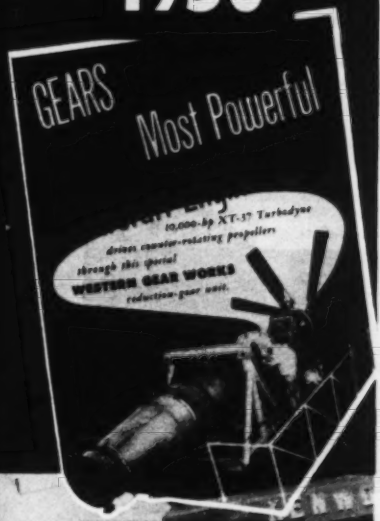

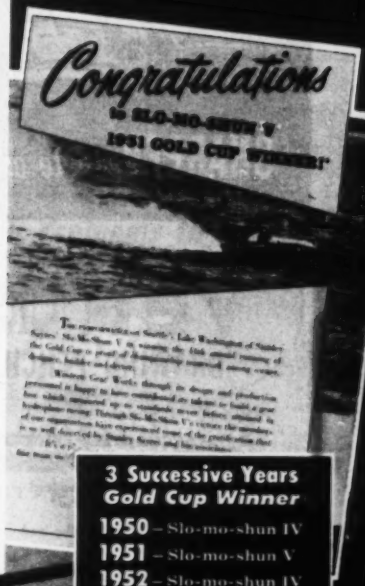

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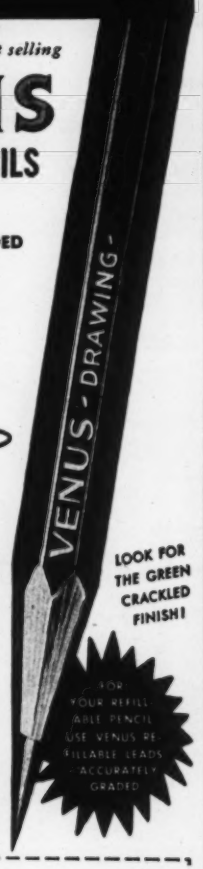

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MECHANICAL ENGINEERING

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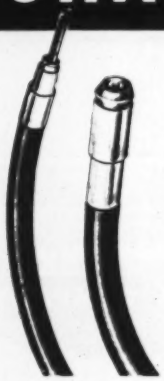

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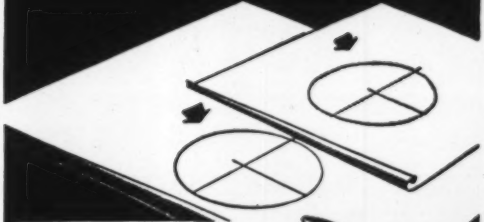

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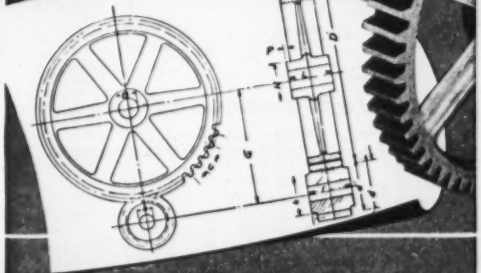

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Rolled or Forged, over 1"	.....	115,000	108,000	100,000	90,000	85,000
Yield Point (divider method)						
Sand Cast	95,000	75,000	60,000	55,000	45,000	40,000
Rolled 1" and under	.....	75,000	65,000	60,000	50,000	45,000
Rolled or Forged, over 1"	.....	75,000	65,000	60,000	50,000	45,000
Elongation in 2"—%						
Sand Cast	10	12	14	15	20	25
Forged or Rolled	.....	12	13		15	20
Reduction in area—%						
Sand Cast	.....	12	14	15	20	25
Forged or Rolled	.....	12	13		15	20
COMPRESSION						
Yield Point—lbs. per sq. in.	70,000	65,000	58,000	50,000	40,000	33,000
Permanent Set at 100,000 lbs. per sq. in. (max.)	.015	.020	.030	.050	.080	.125
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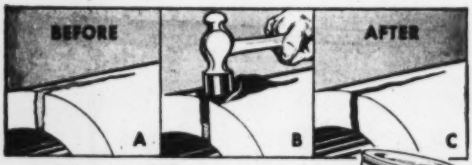

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ASME CATALOG

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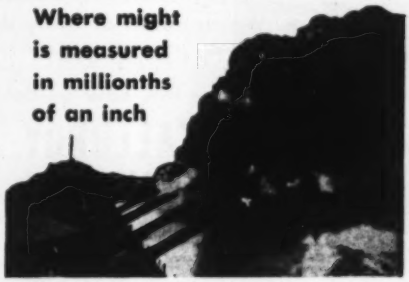
Where might is measured in millionths of an inch



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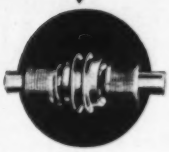

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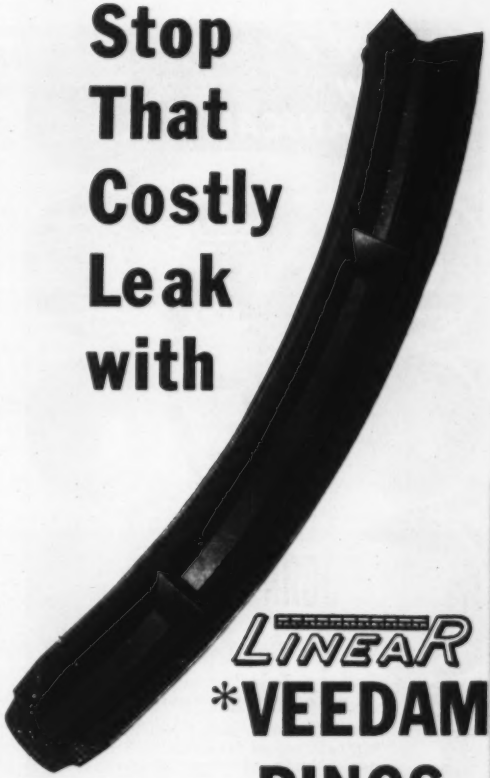

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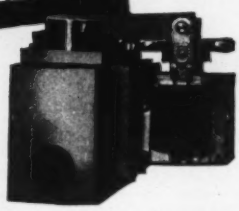

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Positions are available at West Lynn, Mass., and Lockland, Ohio. Do not apply if your best skills are being used for vital defense work. Please send resume to: Technical and Supervisory Personnel, Aircraft Gas Turbine Division, Dept. M.

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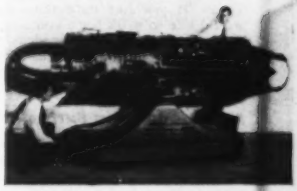
Cutaway of G-E's J47, America's number one production jet. Among the planes powered by this engine is the famed North American F86 Sabre.



G-E engineer congratulates Air Force technician on new engine performance record. G-E jet engineers maintain close contact with engine operation in the field

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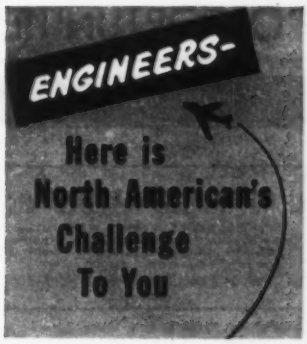

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"OPPORTUNITIES" Section This Month 143-148

POSITIONS OPEN

Continued from Page 147

MECHANICAL ENGINEER

Large Western New York synthetic organic chemical plant has attractive permanent position for Mechanical Engineer, preferably with 2 to 3 years' industrial experience, for plant engineering project work.

Address CA-3939, % "Mechanical Engineering."

PROFESSIONAL ENGINEER—with 10 years' experience in the operation and maintenance of central steam heating plant generating at 125 lbs. Plant at present undergoing extensive maintenance to effect more efficient firing. Must be capable to directing unskilled personnel in the accomplishing of repairs, etc. Plant located in Northeastern New Mexico at elevation of approx. 6400 ft. in city of approx. 10,000, atmosphere very dry, climate moderate. Address inquiries to: Board of Directors, New Mexico State Hospital, Las Vegas, New Mexico, giving full experience record, two references and salary expected.

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This medium size, New York area manufacturer is seeking a Mechanical Engineer with 8 to 10 years of industrial machinery developmental experience to assist Research Director. Applicants must have administrative ability as well as sound research experience. Permanent, non-military position, excellent salary, working conditions, etc. Reply stating experience, education, age and salary requirements. Address CA-4011, care of "Mechanical Engineering."

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MECHANICAL ENGINEERS—Permanent positions open in development program for men with several years' experience, also recent graduates. University of Wichita Foundation for Industrial Research, Wichita 14, Kansas.

RESEARCH ANALYSTS AND ENGINEERS—with or without experience for work in applied mechanics and mathematical analyses. Typical projects include rigid body dynamics, vibrations (including non-linear), thermodynamics and statistical analyses. Minimum requirement M.S. in Applied Mechanics, Physics, Mathematics or equivalent. Salary open. Write R. B. Grant, Southwest Research Institute, P. O. Box 2296, San Antonio, Texas.

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MECHANICAL ENGINEER—to assist in supervision maintenance of fleet of Whitcomb Diesel Electric Locomotives, as well as general railway repair shops, large copper company Chile, South America. 3-year contract. Transportation both ways and salary while traveling paid by company. In reply give complete details. Address CA-4024, care of "Mechanical Engineering."

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DESIGNING DRAFTSMAN—with experience in concrete or mill construction large Copper Company Chile, South America. 3-year contract. Transportation both ways and salary while traveling paid by company. In reply give complete details. Address CA-4027, care of "Mechanical Engineering."

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POSITIONS WANTED

MECHANICAL ENGINEER—Graduate, Registered, 15 years' mechanical engineering experience in industry, 6 years' chief plant engineer. Salary requirement, $8000-$8750. Address CA-4020, care of "Mechanical Engineering."

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52, 70, 71, 107

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THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may affiliate as Associates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

C. E. Davies, Secretary
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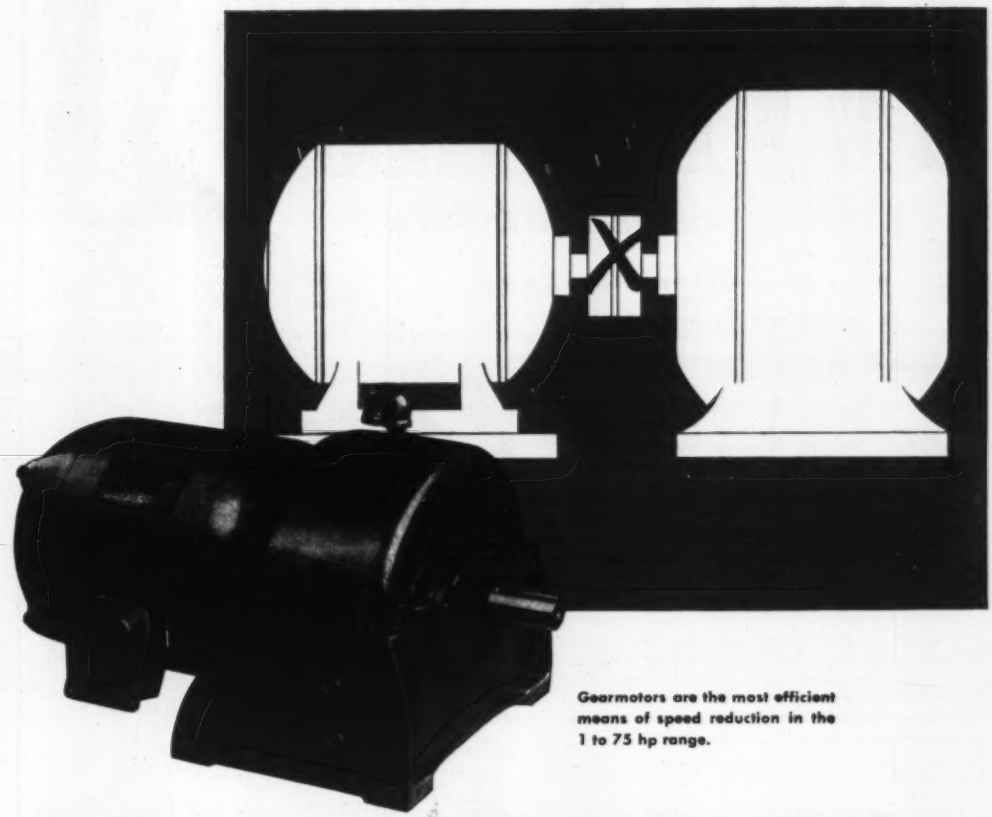

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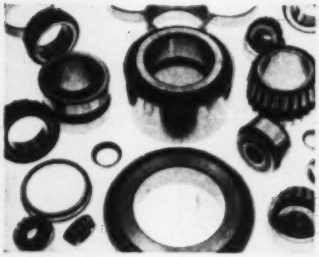
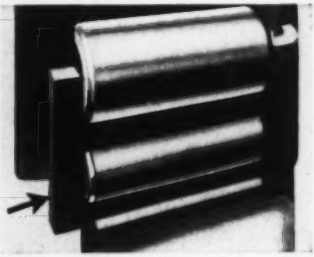
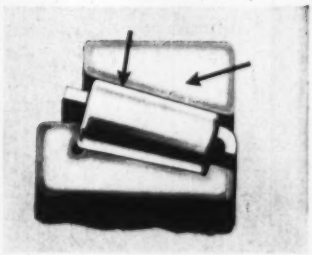


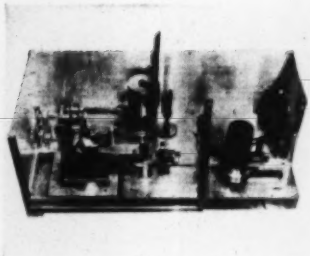
26 TYPES. Because Timken® bearings are made in 26 types, you get exactly the right tapered roller bearing for your job.



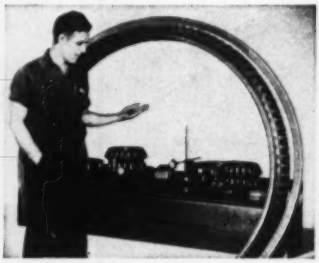
SOFT STEEL CAGE separates the rollers in Timken tapered roller bearings and prevents scuffing.



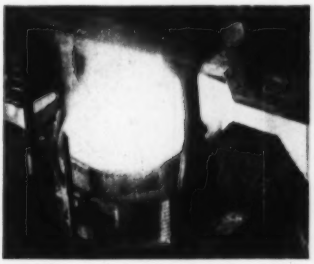
TOUGH INSIDE—HARD OUTSIDE. Case carburizing of rollers and races gives a wear-resistant surface, shock-resistant core.



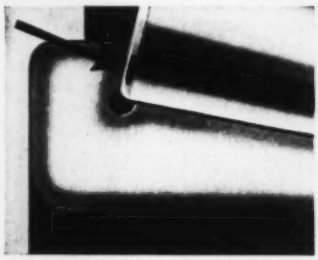
MICRO-INCH FINISH. With help of the profilograph, which measures surface irregularities to a millionth of an inch, the Timken Company has developed a bearing finish of micro-inch accuracy.



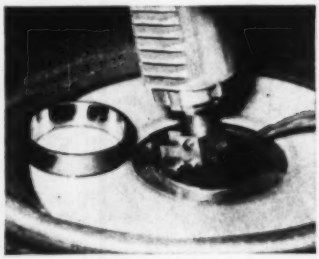
5850 SIZES. If you need a tapered roller bearing smaller around than your finger or as large as 71½" in diameter, you can get it from The Timken Roller Bearing Company.



WE MAKE OUR OWN STEEL. Because Timken bearings are made of special alloy steel, produced in the Timken Company's own mills, they have extra strength and wear resistance.



RIB OF CONE maintains roller alignment, prevents skewing, assures maximum bearing capacity.



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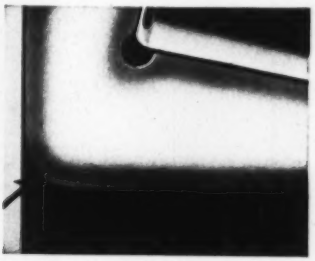

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